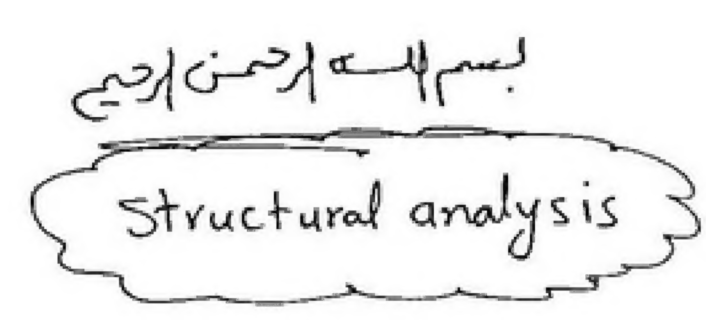




تحليل المنشآت :- هو معرفة القوى الداخلية الناتجة من القوى المؤثرة الخارجية على القطاع (شكل المنشأ) ليتم تصميمها بعد ذلك.

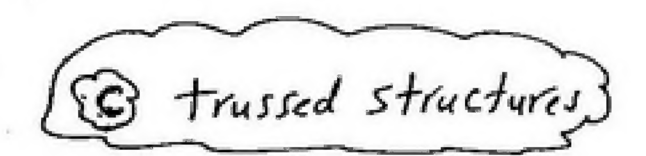
(1) type of structures — أنواع المنشآت

a- beams ← الكمرات

وهو نظام إنشائي عبارة عن عنصر أفقي وقد يكون مائل مثل السلالم ويتم ترتكيزه بركائز.

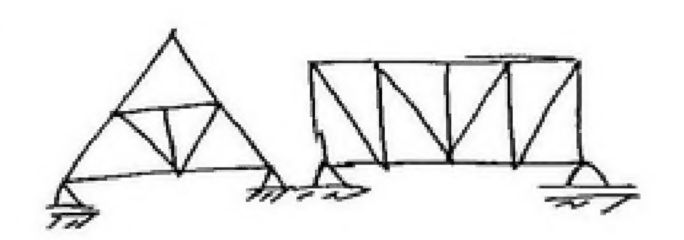
b- Frames — الإطارات

وهي عبارة عن كمرات ركائزها عبارة عن أعمدة



الجمالونات

وهي عبارة عن شبكة من العناصر
تحتها ركائز لتحمل الأحمال وكل عناصرها
عبارة عن link member وهو نظام
لتمرير بعض القوى الداخلية



d - Arch structure

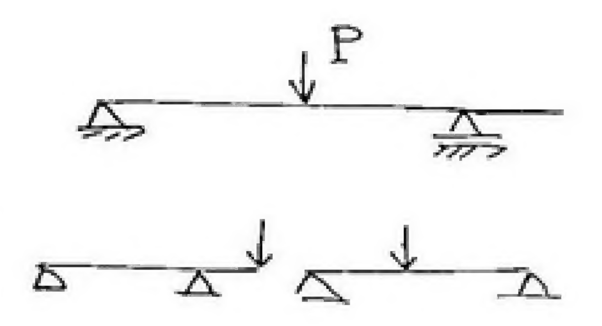
كمرات مقوسة لتحمل الكمرات من
أعلى بدلاً من وضع ركائز تحتها.



(2) shape of External loads

أنواع الأحمال المؤثرة على المنشآت السابقة.

(i)- Concentrated Load



حمل مركز عند نقطة معينة

قد يكون في نصف الكمرة أو يكون عند أحد الركائز

أو أي مكان من الكمرة

(ii)- uniform Load

w t/m

حمل موزع على كامل طول الكمرة أو جزء معين منها

وهو عبارة عن حمل مفرود على الكمرة مثل وزن رمل على الكمرة كلها مثلاً

2t/m

3m

معنى ذلك أنه على كل متر يوجد ٢ طن وليكن شكاير اسمنت

∴ على كامل الكمرة يكون هناك ٢*٣ = ٦ طن

ويمكن تركيزها كالتالي ويكون في نصف الحمل الموزع على بعد 1.5m

6t

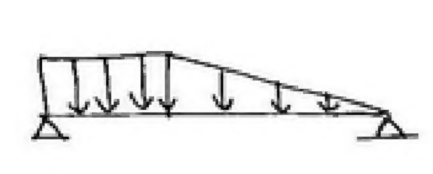
1.5m | 1.5m

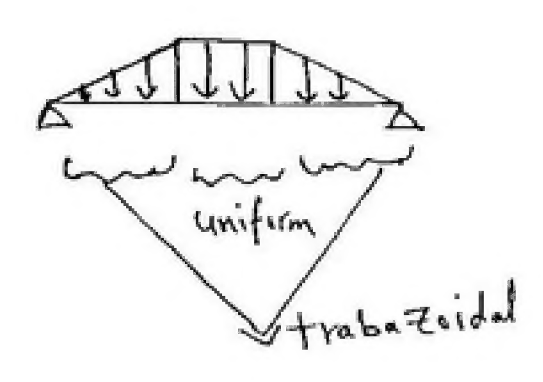
(iii)- trabazoidal load



هو حمل يزيد في أماكن على الأخرى عن
أماكن أخرى في شكل حمل مثلث

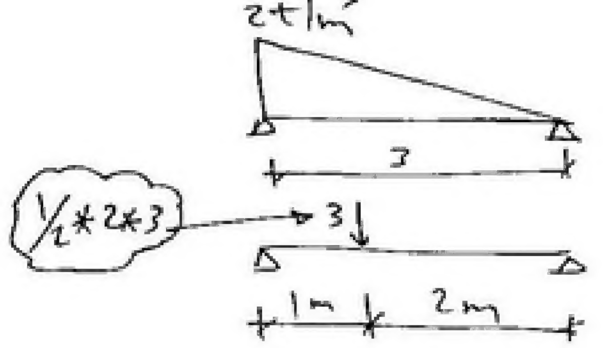
* نلاحظ انه الحمل في أماكن أكبر من الأخرى
مثل وضع شكائر على أول متر ثم شكارتين ثم ثلاثة

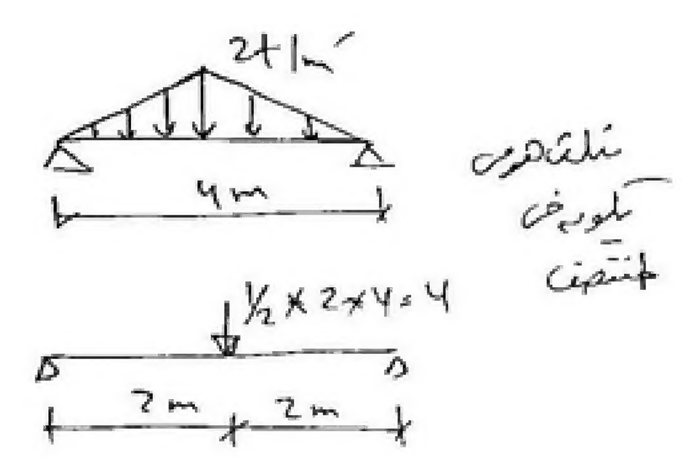




نقطة تركيزه ⟸ المستطيل في نصفه.

⟸ المثلث في الثلث من ناحية القيمة الكبيرة.





مثلث هرمي يكون في المنتصف

3 - loads

** من النقطة السابقة عرفنا أشكال الأحمال ، لكن مسببات الأحمال هي الآتي :-

(i) dead load

الحمل الناتج عن وزن الكمرة فقط (بسبب الحمل الميت) لو وضعنا نخلة بين طرفي جسر ترعة نجدها خلال الا تتقوس وقد يحدث فيها كسر حتى من غير مارة عليها وذلك بسبب وزنها .

(ii) live load

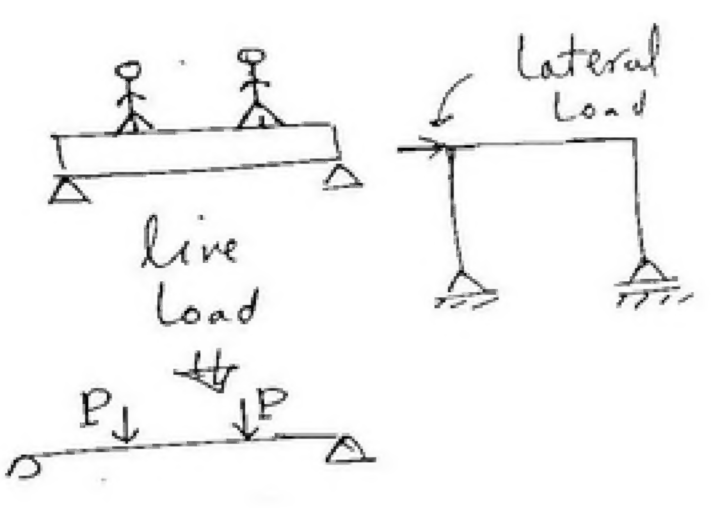
الحمل الحي وهو ناتج عن وجود أشخاص تمر على هذا المنشأ

(iii) lateral load

الأحمال السابقة تكون رأسية على القطاع أما هذا النوع من الأحمال تكون أفقي موازي لسطح الأرض يأتي بسبب الزلازل والرياح .

وزن الكمرة

dead load



4- supports

الركائز

هي التي تحمل المنشأ بالأحمال الآتية عليه.

$\downarrow P$

غير مستقر ستتجه هذه الكرة لأسفل.

أما هنا فالكرة مستقرة حيث تحمل الركائز الحمل
في الاتجاه المعاكس حتى تكون محصلة الأحمال
= صفر

$\downarrow P$; $\uparrow R_1$; $\uparrow R_2$

$$R_1 + R_2 = P$$

× من هذه النقطة سيتم شرح معنى الركائز وكيفية وجودها في الطبيعة ×

1 Roller support

× هذه الركيزة مسموح لها بالتحرك في الاتجاه الأفقي
وبالتالي لا يوجد عليها رد فعل معاكس في الاتجاه الأفقي

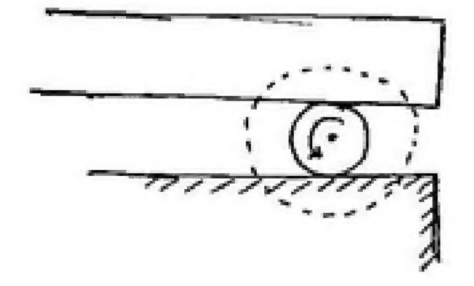
$\uparrow YA$

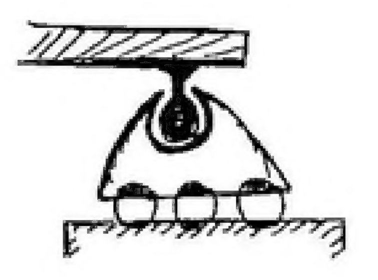
× ومسموح لها بالدوران عند نقطة التقائها بالكرة
وبالتالي فلا يوجد رد فعل مقاوم للدوران

× أما في الاتجاه الرأسي فغير مسموح لها بالحركة الرأسية
ومن ثم يوجد عليها رد فعل رأسي

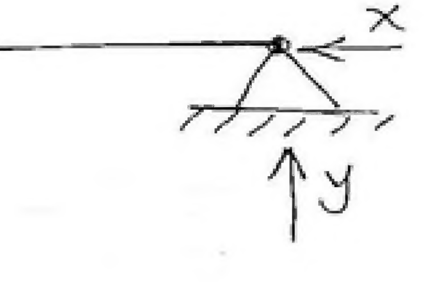
YA

** توجد هذه الركيزة في الكباري بنفس الشكل التالي





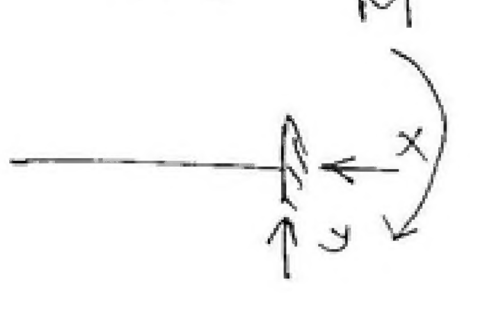
2 hinged support



* مسموح بالدوران فقط.
* غير مسموح بالحركة الرأسية (Y)
  والحركة الأفقية (X)

* أقرب الأمثلة الشبيهة له في الواقع ارتباط الكمرة بالعمود حيث يعتبر العمود ركيزة للكمرة الرئيسية.

3 Fixed support



* غير مسموح له بالحركة الرأسية Y↑
  X→ الأفقية " " "
  ↷M بالدوران " " "

غير مسموح بالحركة الأفقية والرأسية والدورانية

4- Spring support

هل شبيه بال Roller لكنه

يحدث هبوط عندها

$\Delta \leftarrow$ الهبوط

$P \rightarrow$ الحمل

K :- معاير الزنبرك

$$K = P/\Delta$$

غير مقرره في منهج السنه دي .

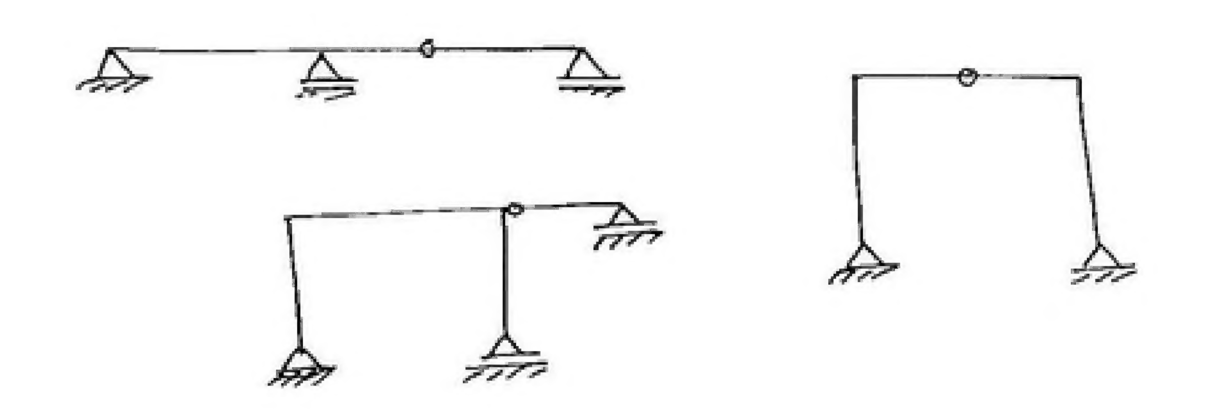
5-Intermediate hinge   مفصلة

تستخدم لتحرير العزوم عند نقطة من الكمرة وهي تشبه في وضعها المفصلة العادية

وبالتالي فإن العزوم تكون معروفة عند هذه النقطة = صفر

$$\Sigma M_{@point} = zero$$

وبالتالي فهي تزود معادلة إضافية على معادلات الاتزان الثلاثة .



لاحظ أنها لو ربطت عنصرين ⟸ تزود معادلة إضافية .

ثلاثة عناصر ⟸ " معادلتين إضافيتين .

∴ نرى عدد العناصر التي اشتركت فيها ونطرح واحد ويكون

عدد المعادلات الإضافية

(1)   (1)   2   2   1



determination of Reaction

طريقة إيجاد الـ Reaction لمنشأ ما كالآتي :-

يتم إستخدام الثلاث معادلات

$$
\begin{cases}
\Sigma X = 0.0 \\
\Sigma y = 0.0 \\
\Sigma M = 0.0
\end{cases}
$$

Example ①

A — 3t/m' — 2t — B, X_B; y_A, y_B; 5m, 5m

* $\Sigma X = 0.0$

$\Rightarrow X_B = 0.0$

(30 ↓, 2 ↓)

* $\Sigma M_A = 0.0$

$\Rightarrow 2*5 + 30*5 - y_B*10 = 0.0$

$\Rightarrow y_B = 16 \text{ ton}$

* $\Sigma y = 0.0$

$\Rightarrow y_A + 16 = 2 + 30 \Rightarrow y_A = 16t$

لاحظ أن هذا المنشأ متماثل من الركائز والأحمال وبالتالي فإن كل support يأخذ مثل الآخر.

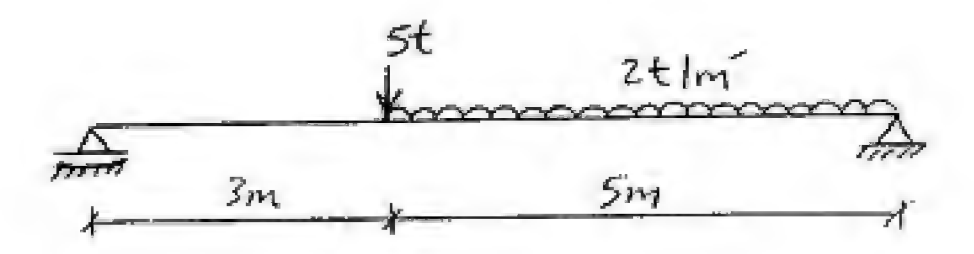
$$y_A + y_B = 30 + 2 \qquad y_A = y_B$$

$$\Rightarrow y_A = y_B = 32/2 = 16 \text{ ton}$$

16 16

$$\begin{bmatrix} X_A \\ y_A \\ y_B \end{bmatrix} = \begin{bmatrix} 0 \\ 16 \\ 16 \end{bmatrix}$$





– Sol –

5, 10, X_B

Y_A 3 2.5 2.5 Y_B

* $\sum X = 0.0$

$X_B = 0.0$

* $\sum M_A = 0.0$

$5 * 3 + 10 * 5.5 = Y_B * 8$

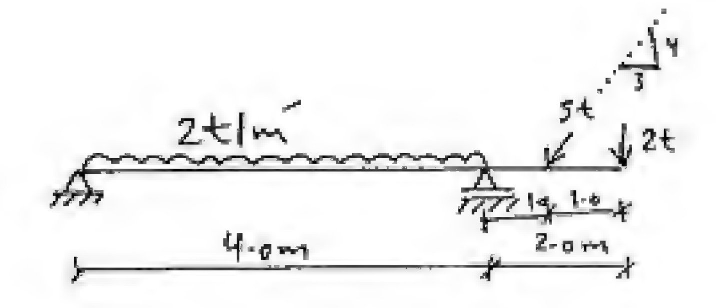
$\Rightarrow Y_B = 8.75$ ton

* $\sum Y = 0.0$

$Y_A + Y_B = 15$

$\therefore Y_A = 15 - 8.75 = 6.25$ ton

Example (2)



— Sol —

$5\sin\theta = 4$

3, 4, 3

$\theta = \tan^{-1}\frac{4}{3} = 53.13$

$\cos\theta = 0.6$

$\sin\theta = 0.8$

X_A, 8, 4, 2t, 3, y_A, y_B

$* \sum F_x = 0.0$

$X_A = 3.0$ ton

$* \sum M_A = 0.0$

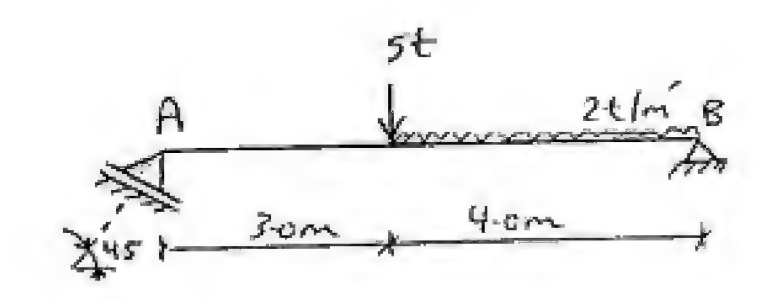
$8 \times 2 + 4 \times 5 + 2 \times 6 = y_B \times 4$

$\Rightarrow y_B = 12$ ton.

$* \sum F_y = 0.0$

$y_A = 8 + 4 + 2 - 12 = 2t$

Example



— Sol —

R sin45   5t   8 X_B

R   R Cos45 Y_B

* $\sum M_A = 0.0$

$$5 \times 3 + 8 \times 5 - Y_B \times 7 = 0.0$$

$$Y_B = 7.86 \text{ ton}$$

* $\sum Y = 0.0$

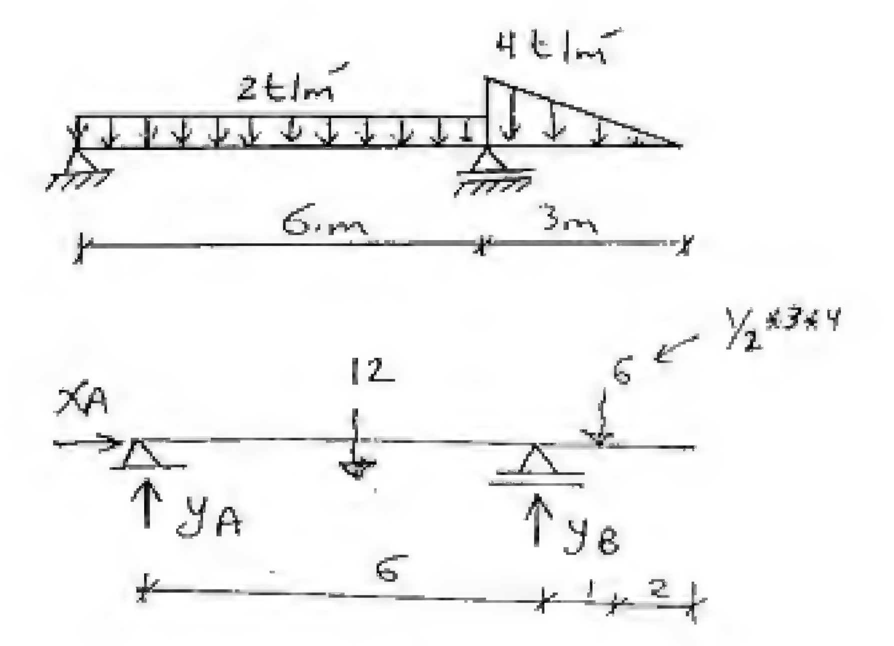
$$R \cos 45 = 13 - 7.86$$

$$\therefore R = 7.27 \text{ ton}$$

* $\sum X = 0.0$

$$X_B = R \sin 45 = 5.14 \text{ ton}$$

Example



* $\sum X = 0.0$

$\therefore X_A = 0.0$

* $\sum M_A = 0.0$

$12*3 + 6*7 = Y_B * 6$

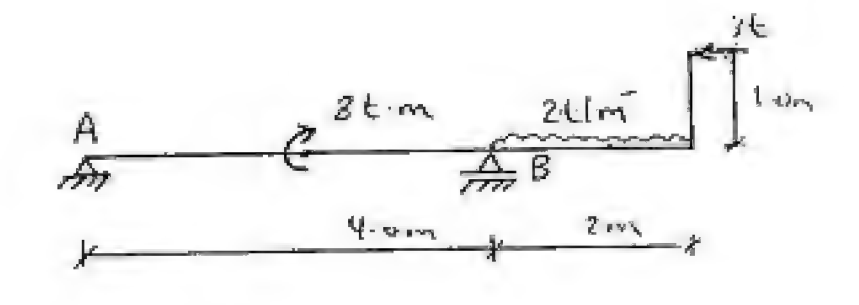
$\therefore Y_B = 13 \text{ ton}$

* $\sum Y = 0.0$

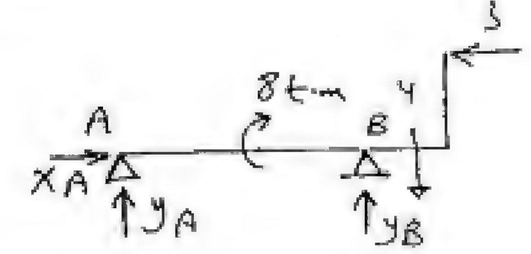
$Y_A + Y_B = 12 + 6$

$Y_A = 5 \text{ ton}$

Example



— Sol —



* $\sum X = 0.0$

$\Rightarrow X_A = 3$ ton.

* $\sum M_A = 0.0$

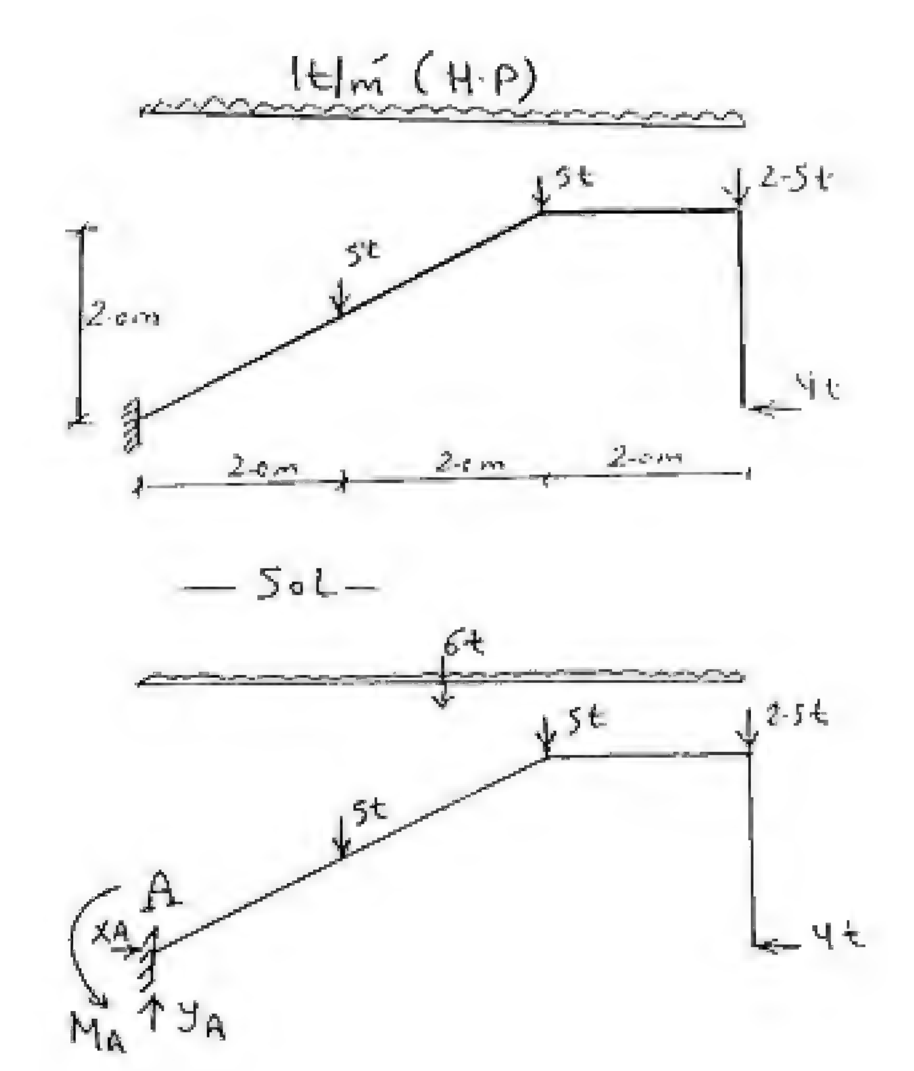
$\Rightarrow 8 + 4 * 5 - 3 * 1 = Y_B * 4$

$\Rightarrow Y_B = 6.25$ ton.

* $\sum Y = 0.0$

$\therefore Y_A = 4 - 6.25 = -2.25$ ton

Example



* $\sum X = 0.0$

$$X_A = 4 \text{ ton}$$

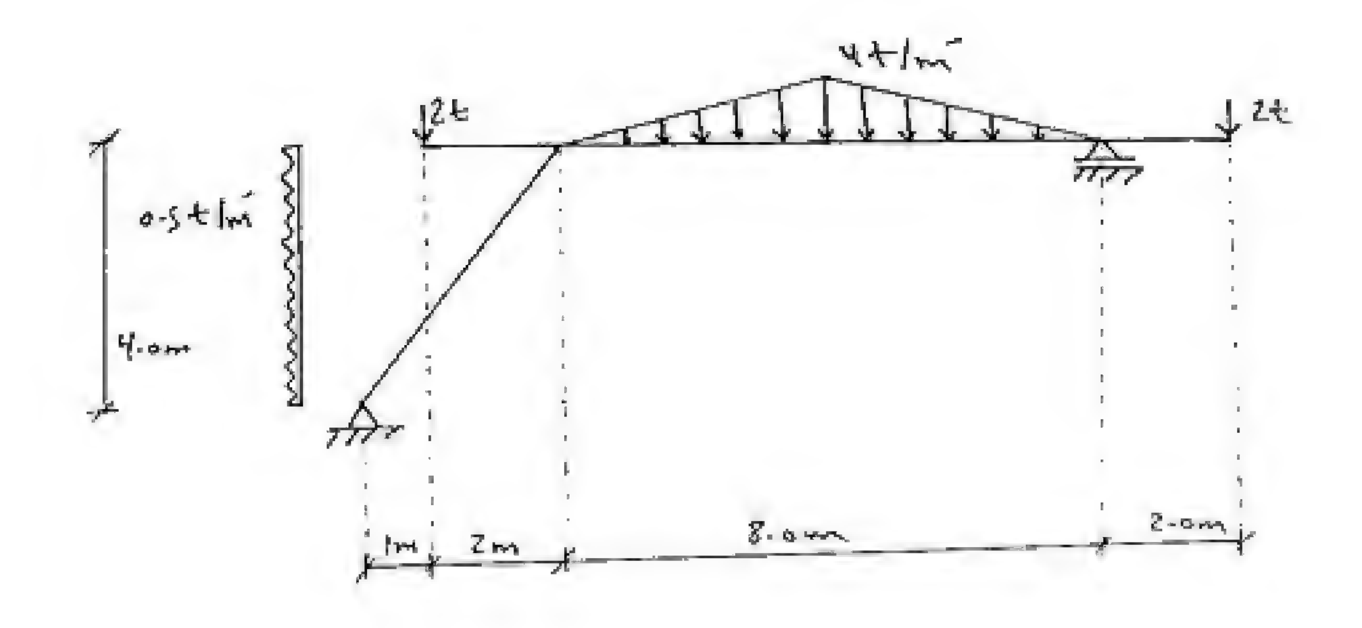
* $\sum Y = 0.0$

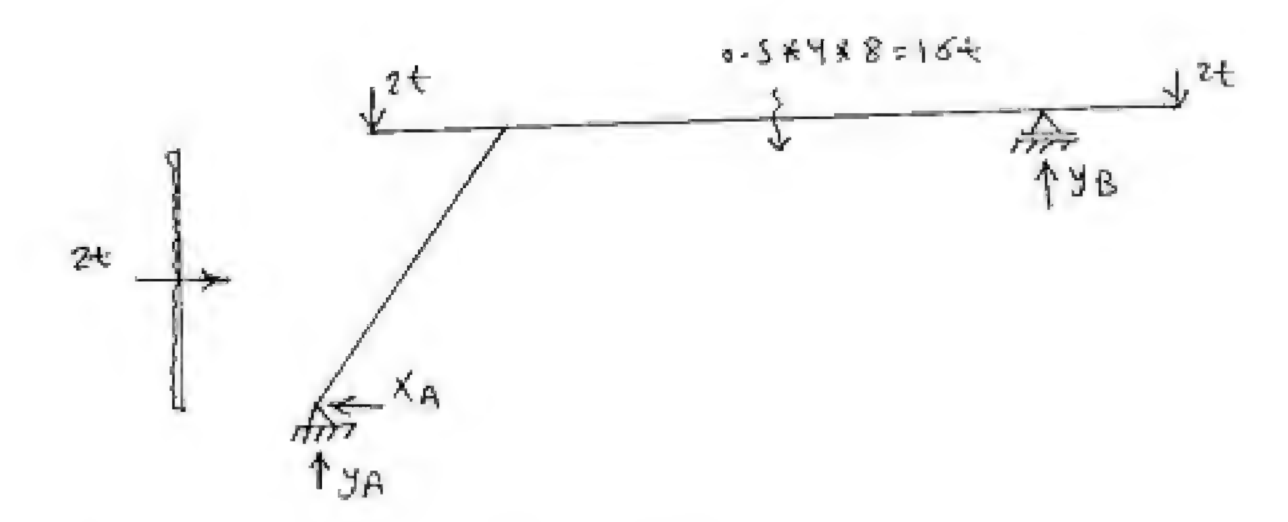
$$Y_A = 5 + 5 + 2.5 + 6 = 18.5 \text{ ton}$$

* $\sum M_A = 0.0$

$$M_A - 6*3 - 5*2 - 5*4 - 2.5*6 = 0.0 \Rightarrow M_A = 63 t$$

$$\therefore M_A = 63 \text{ t.m}$$



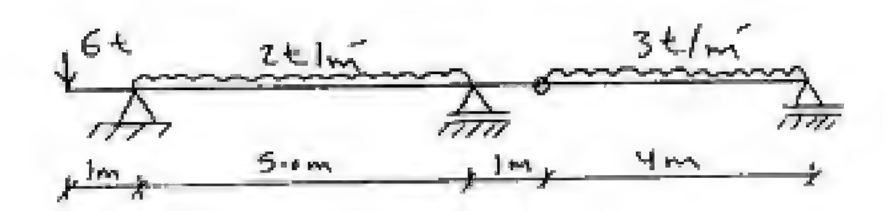


$\Sigma X = 0.0 \Rightarrow X_A = 2 \text{ ton}$

$\Sigma M_A = 0.0 \Rightarrow 2*2 + 2*1 + 16*7 + 2*13 = Y_B * 11$

$\Rightarrow Y_B = 13.1 \text{ ton}$

$\Sigma y = 0.0 \Rightarrow Y_A = 2 + 16 + 2 - 13.1 = 6.9 \text{ ton}$

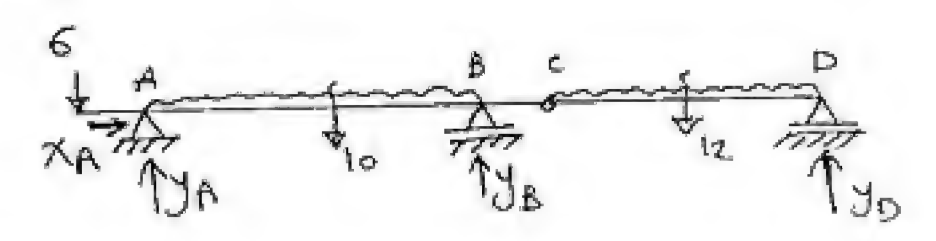


* حالة وجود "Intermediate hinge" هناك طريقتين للحل :-



يتم عمل الثلاث معادلات + يتم اضافة معادلة (I.h) رابعة

$\Sigma M_{Left} = 0.0$ أو $\Sigma M_{right} = 0.0$



* $\Sigma M_{c_{Right}} = 0.0$

$\Rightarrow \quad y_D * 4 = 12 * 2$

$\Rightarrow \quad y_D = 6 \text{ ton}.$

$* \ \Sigma x = 0.0$

$\Rightarrow \ x_A = 0.0$

$* \ \Sigma M_A = 0.0$

$$-6*1 + 10*2.5 + 12*8 - 6*10 - y_B * 5 = 0.0$$

$$\Rightarrow y_B = 11 \text{ ton}$$

$* \ \Sigma y = 0.0$

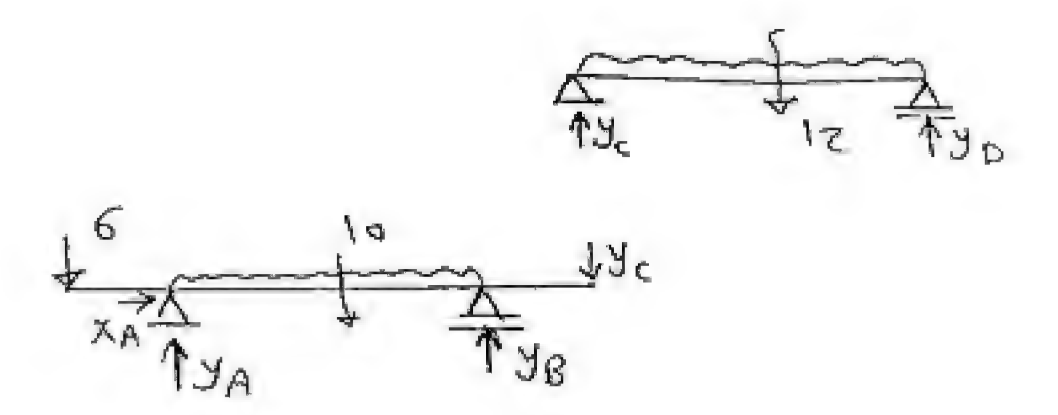
$$\Rightarrow y_A = 6 + 10 + 12 - 11 - 6$$

$$= 11 \text{ ton}$$

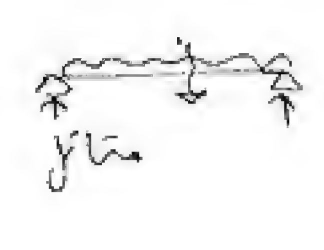
الطريقة الثانية : وهي فصل الجزئين عن بعض ويتم نزع الاتصال تماماً كله ويتم

وضع الجزء Free تماماً ، hinge لها ويتم ارتكاز

له Reaction في الـ ع الطرف على الجزء المعلق .

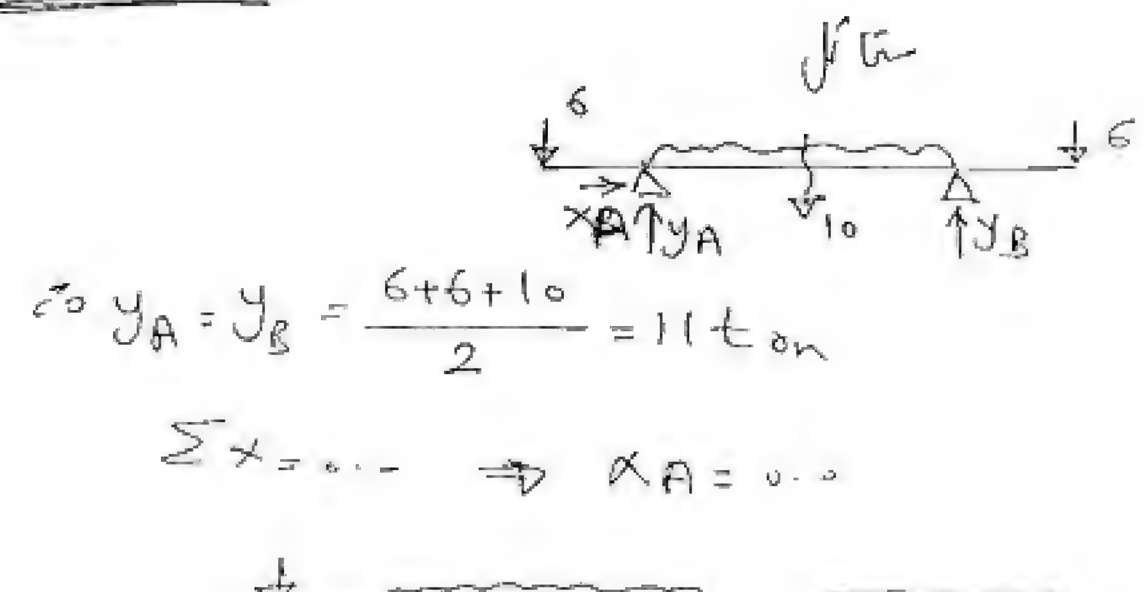


Part C – D



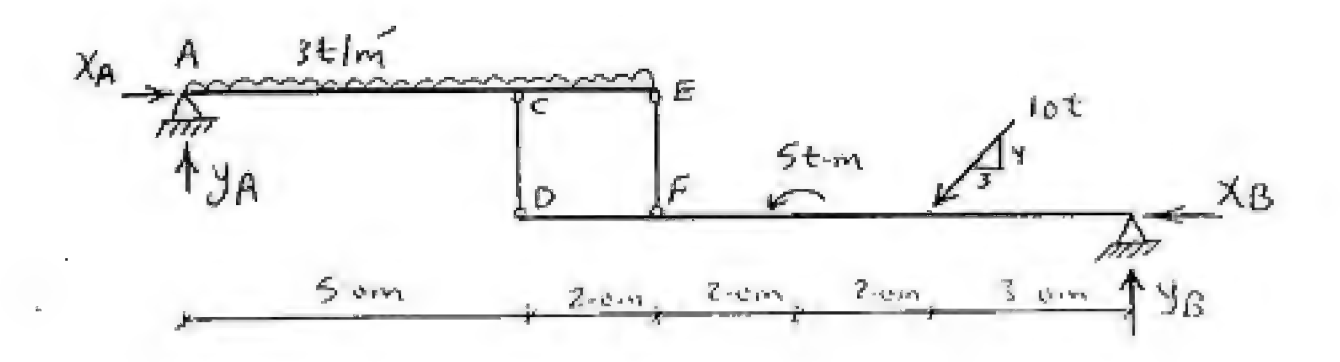
$$y_C = y_D = \frac{12}{2} = 6t$$

Part A — C

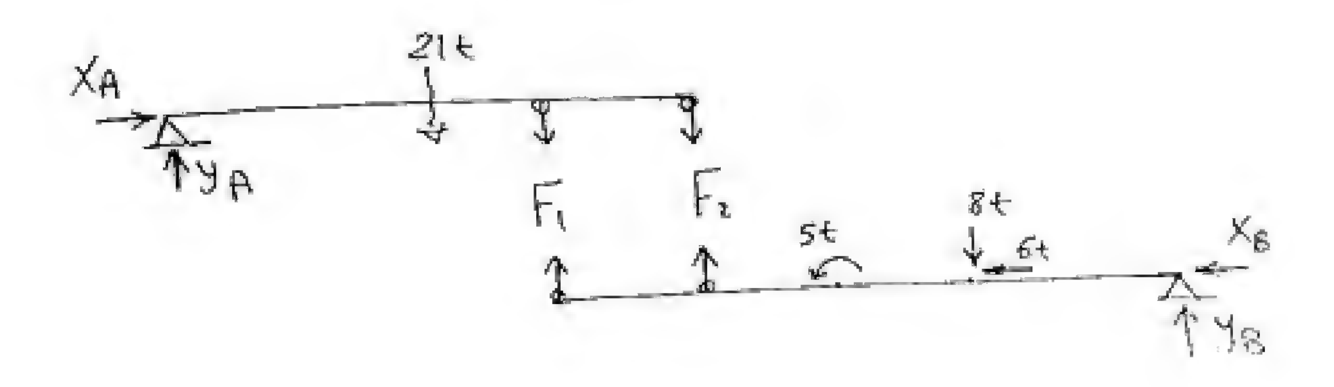


$$\therefore y_A = y_B = \frac{6+6+10}{2} = 11\ ton$$

$$\sum x = 0 \Rightarrow x_A = 0$$



* عندما تجد عنصر بين إثنين Intermediate يكون فى هذا العنصر قوه واحده فى اتجاهه * هذا الشكل عباره عن منشأين (٦ معادلات) ويوجد بها [٦ مجاهيل]



Part A → E

$X_A = 0.0$

Part D → B

$X_B = -6\ ton$

For part ①

→ * $\Sigma M_A = 0.0$

$$21 * 3.5 + 5F_1 + 7F_2 = 0.0$$

$$5F_1 + 7F_2 = -73.5 \longrightarrow ①$$

For part ②

→ * $\Sigma M_B = 0.0$

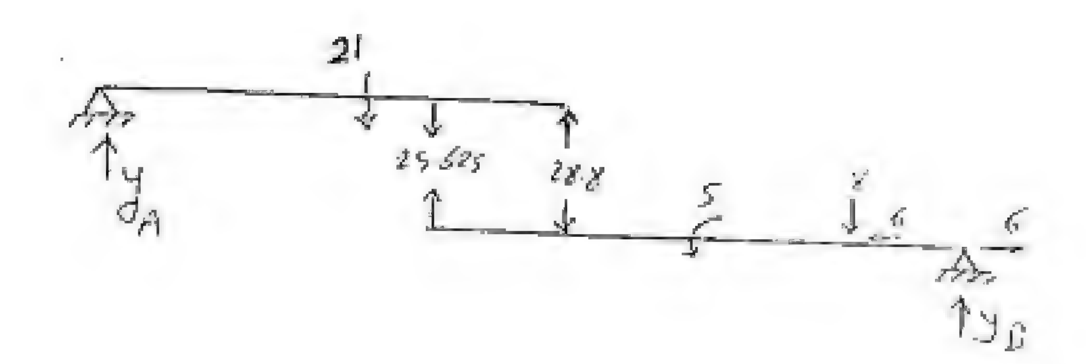
$$8 * 3 + 5 - 7F_2 - 9F_1 = 0.0$$

$$9F_1 + 7F_2 = 29 \longrightarrow ②$$

$\therefore$

$$\therefore f_1 = 25.625 \text{ ton}$$

$$f_2 = -28.8 \text{ ton}$$



Part ①

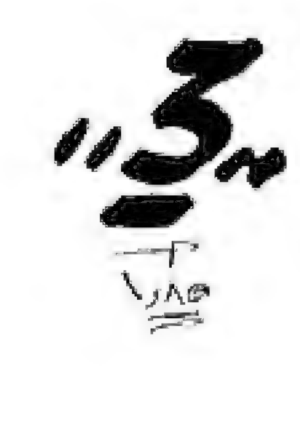
$$y_A = 21 + 25.625 - 28.8 = 17.825\ t$$

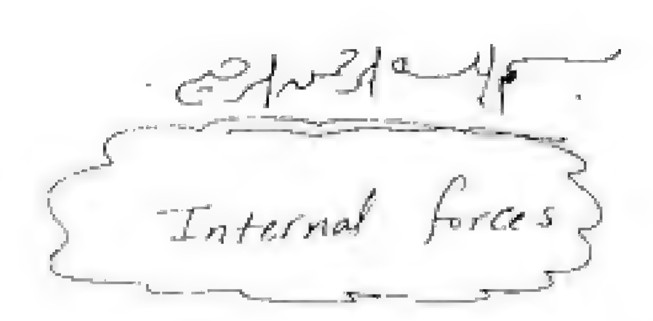
Part ②

$$y_B = 28.8 + 8 - 25.625$$

$$= 11.175\ \text{ton}$$

ok



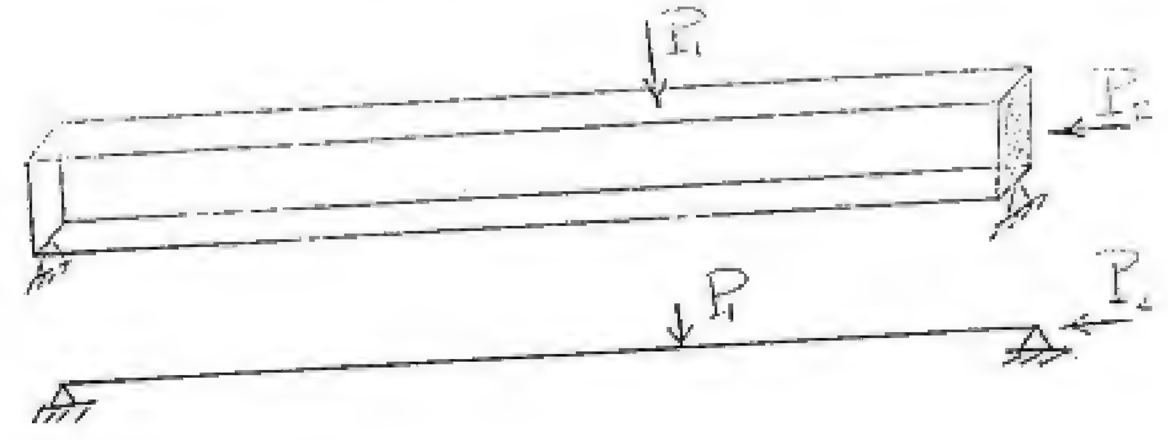


القوى الداخلية تتولد داخل الكمرات وهي بسبب القوى الخارجية وهذا ما يسبب

وهو الشد أو الضغط ← normal force وهي قوى موازية للكمرة.

القص ← Shear force وهي قوى موازية لمساحة المقطع

العزم ← Bending diagram وهي العزوم الناتجة على الكمرة

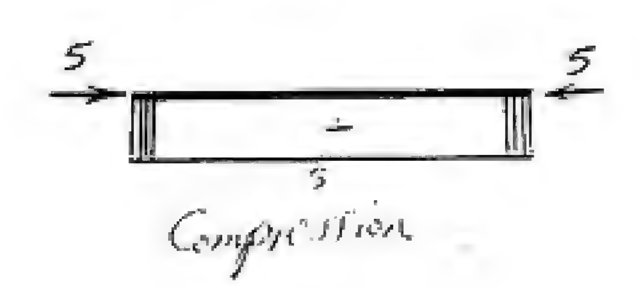


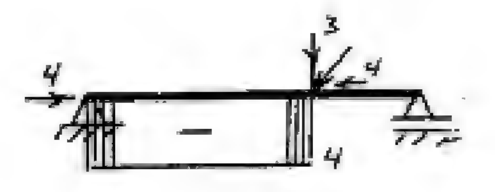
P_1 → موازي لمساحة المقطع

P_2 → موازي للكمرة عمودي على مساحة المقطع.

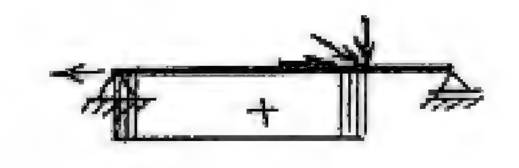


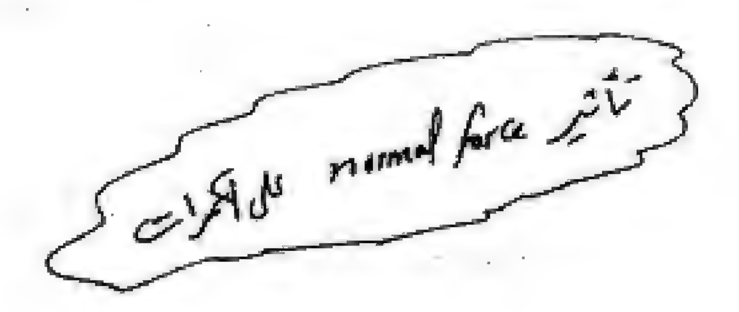
* هو شد أو ضغط على الكمرة ويكون القوة المؤثرة موازي للكمرة ويتم رسم الـ normal بين نقطتين القوة المؤثرة.

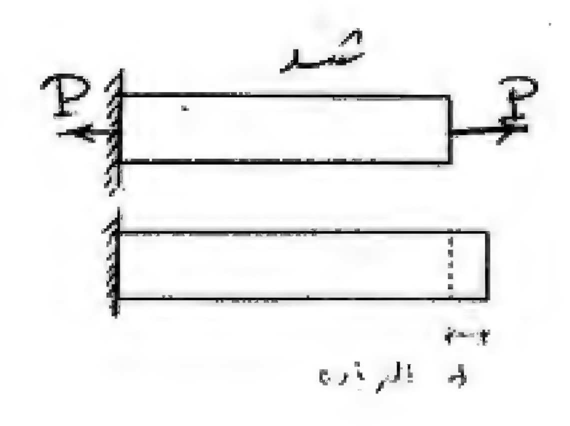


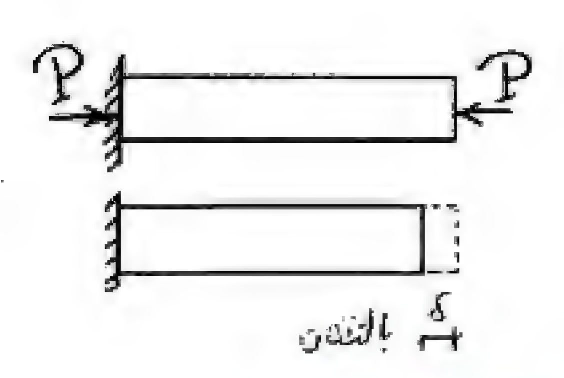


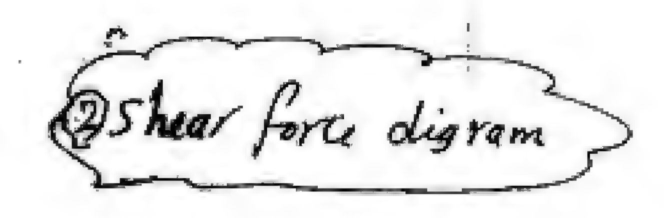






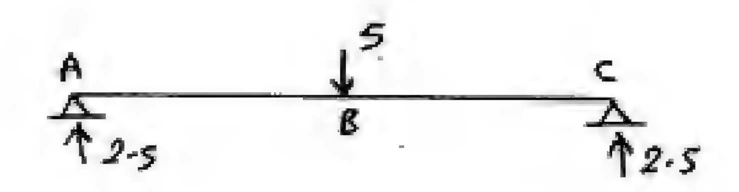


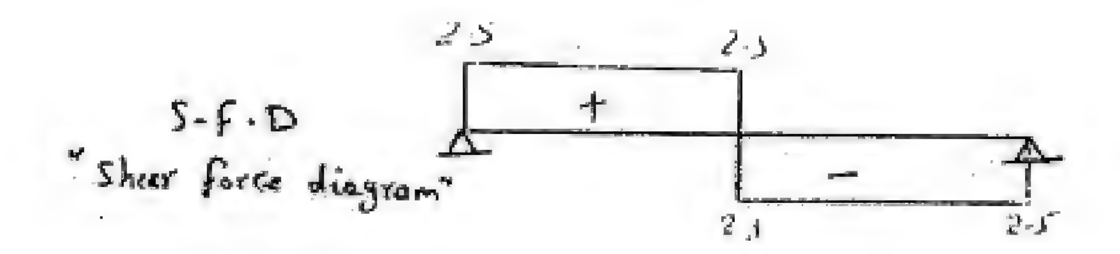




قوى القص المتولدة داخل الكمرة

هي قوى موازية للقطاع عمودية على الكمرة ومحورها





لرسم **S.F.D**

١- نبدأ من الشمال ، نمشي مع اتجاه القوى باتجاه اليمين.

مثلاً الشمال البسيط بأول قوة من الشمال ↑2.5 لأعلى عند A

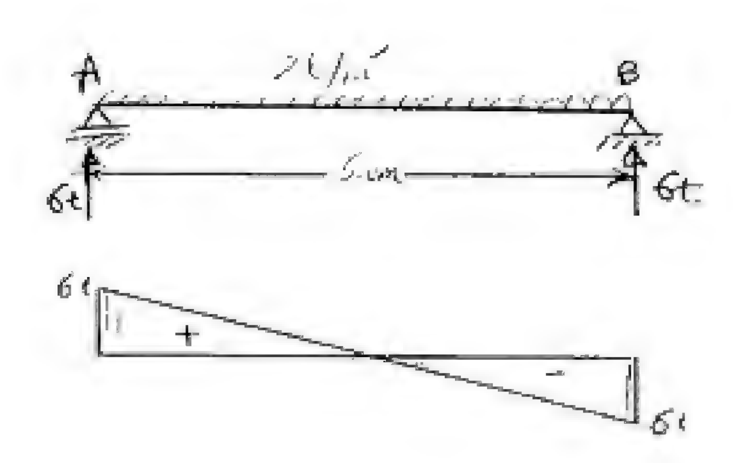
ثم تبقى ثابتة حتى B عند ↓5 لأسفل فتهبط

حتى 2.5- ثم تبقى ثابتة حتى B ← C

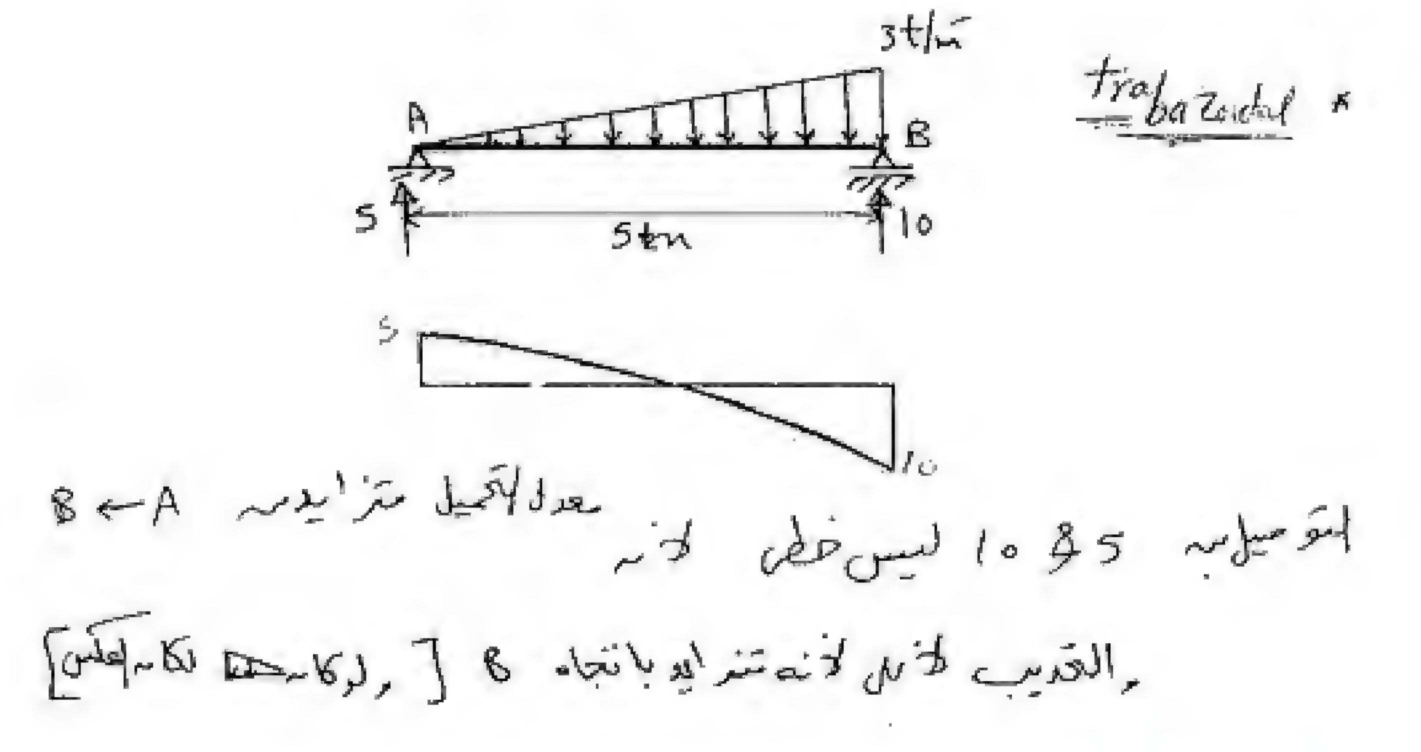
حتى تصل C ← يقفل بـ ↑2.5 لأعلى

فيصل للصفر ⇐ لازم يقفل الـ shear

* حالة الحمل الموزع



نصعد لأعلى بالحمل أساسه موزع لكل المتر وبالتالي عند النقطة A
6t لأعلى وبالتالي يرتفع الخط لأعلى 6 ثم بالتدريج B ← كل متر ينزل
2t لأسفل حتى يكتمل 12t لأسفل عند النهاية فينزل الخط
حتى 6t سالب ولكن يكون خط مائل (لأنه كل متر 2t) لأسفل



التوصيل بين 5 و 10 ليس خطي لأنه معدل التحميل متزايد A ← B
والتدريب لأعلى لأنه متزايد باتجاه B [ولو كان ◺ لكان العكس]

③ Bending moment diagram

العزم هو عبارة عن القوة * المسافة فيتم الوقوف عند أماكن القوى

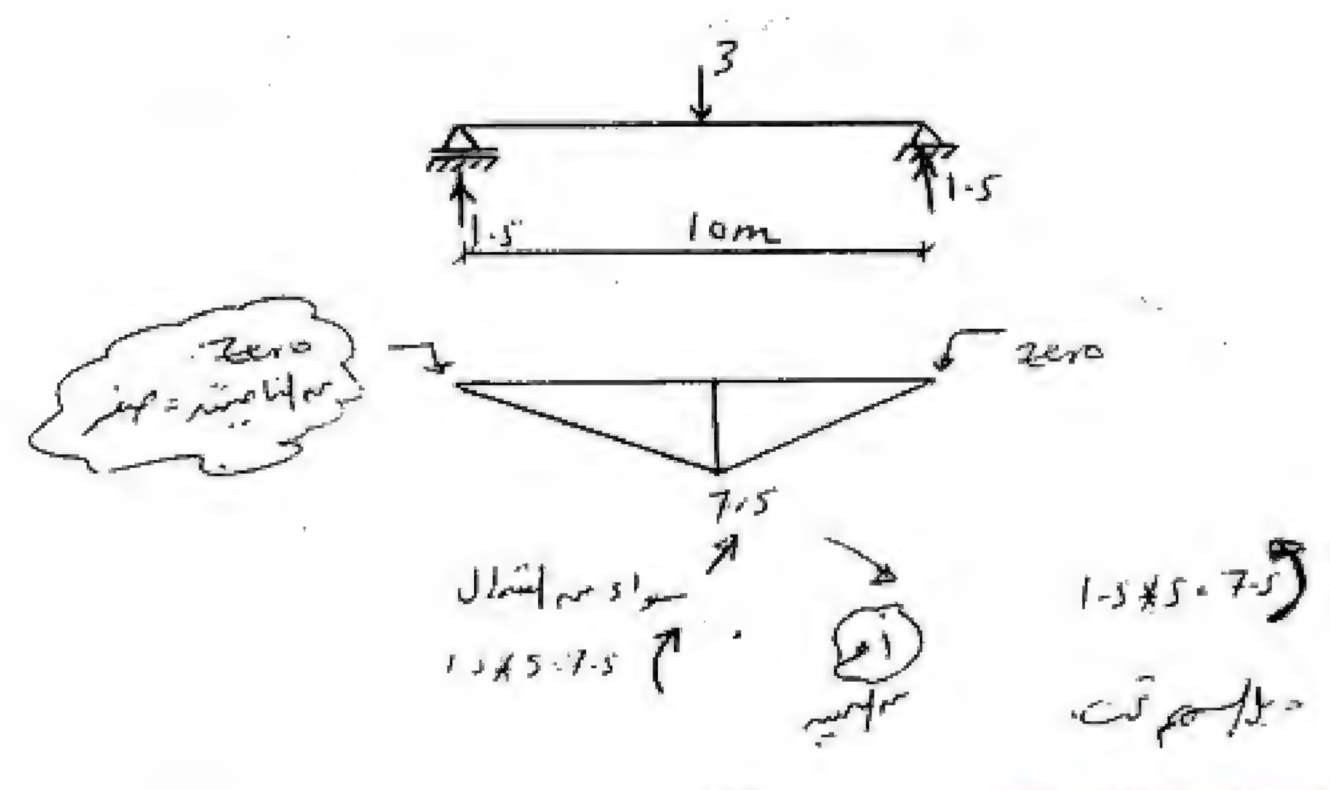
وحساب العزم سواء كان من اليمين أو اليسار ويتم وضع تحت أو فوقه

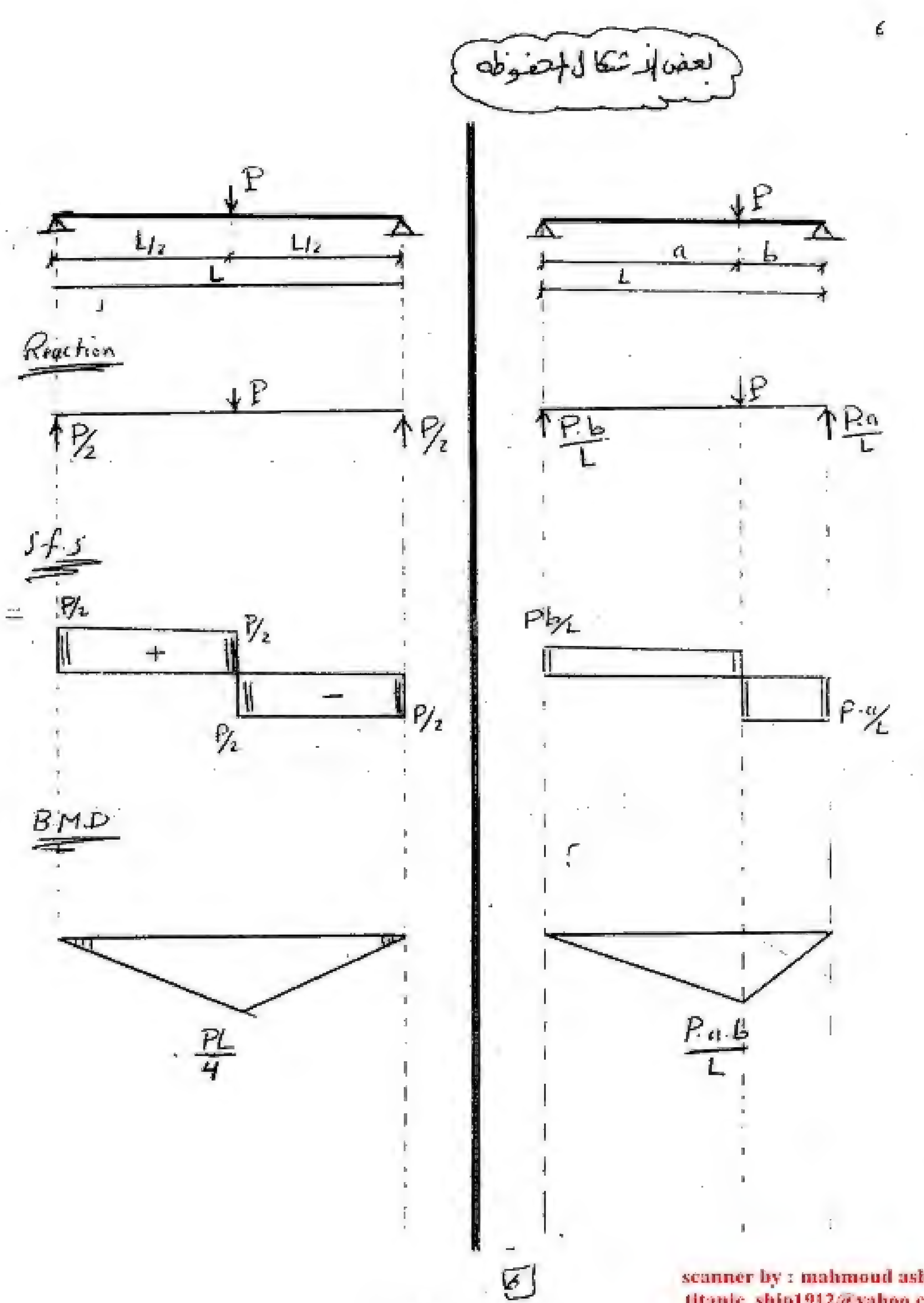
على أساس ⇐

فوقه تحت

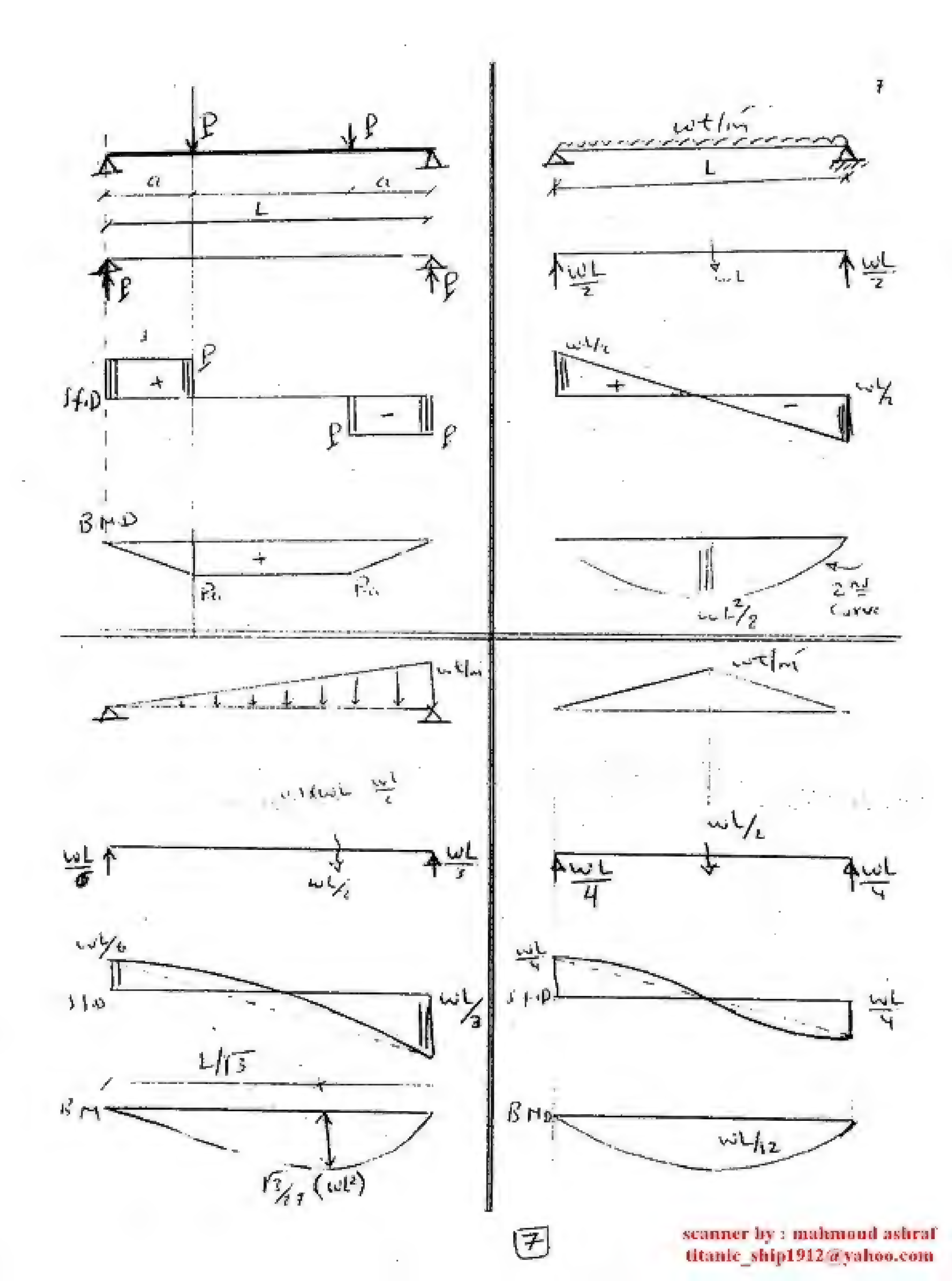
فوقه تحت يتم رسمه مع ذيل السهم.

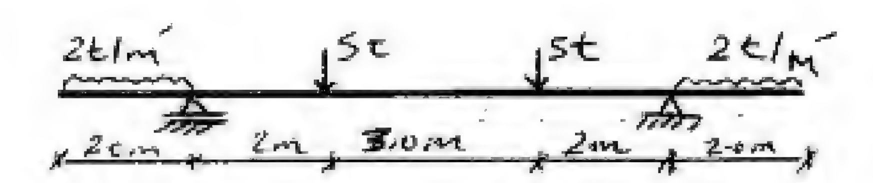
* عندما يكون هناك حمل مركز يتم حساب العزم في بداية وطرفيه ومنتصفه





بعض أشكال محفوظة
P
L/2
L/2
L
Reaction
P
P/2
P/2
S.F.D
P/2
P/2
+
−
P/2
P/2
B.M.D
PL/4
P
a
b
L
P
P.b/L
P.a/L
Pb/L
P.a/L
P.a.b/L


P
P
a
a
L
P
P
SFD
P
+
P
-
P
BMD
+
Pa
Pa
wt/m'
L
wL/2
wL
wL/2
+
-
wL²/2
2nd curve
wt/m'
wL/6
wL/2
wL/3
SFD
wL/3
L/√3
BM
√3/27 (wL²)
wt/m'
wL/2
wL/4
wL/4
SFD
wL/4
BMD
wL/12



for the following beam

it's Required :- (i) find all Reactions

(ii) draw N.F.D , S.F.D and B.M.D

— sol —

1- For Reaction

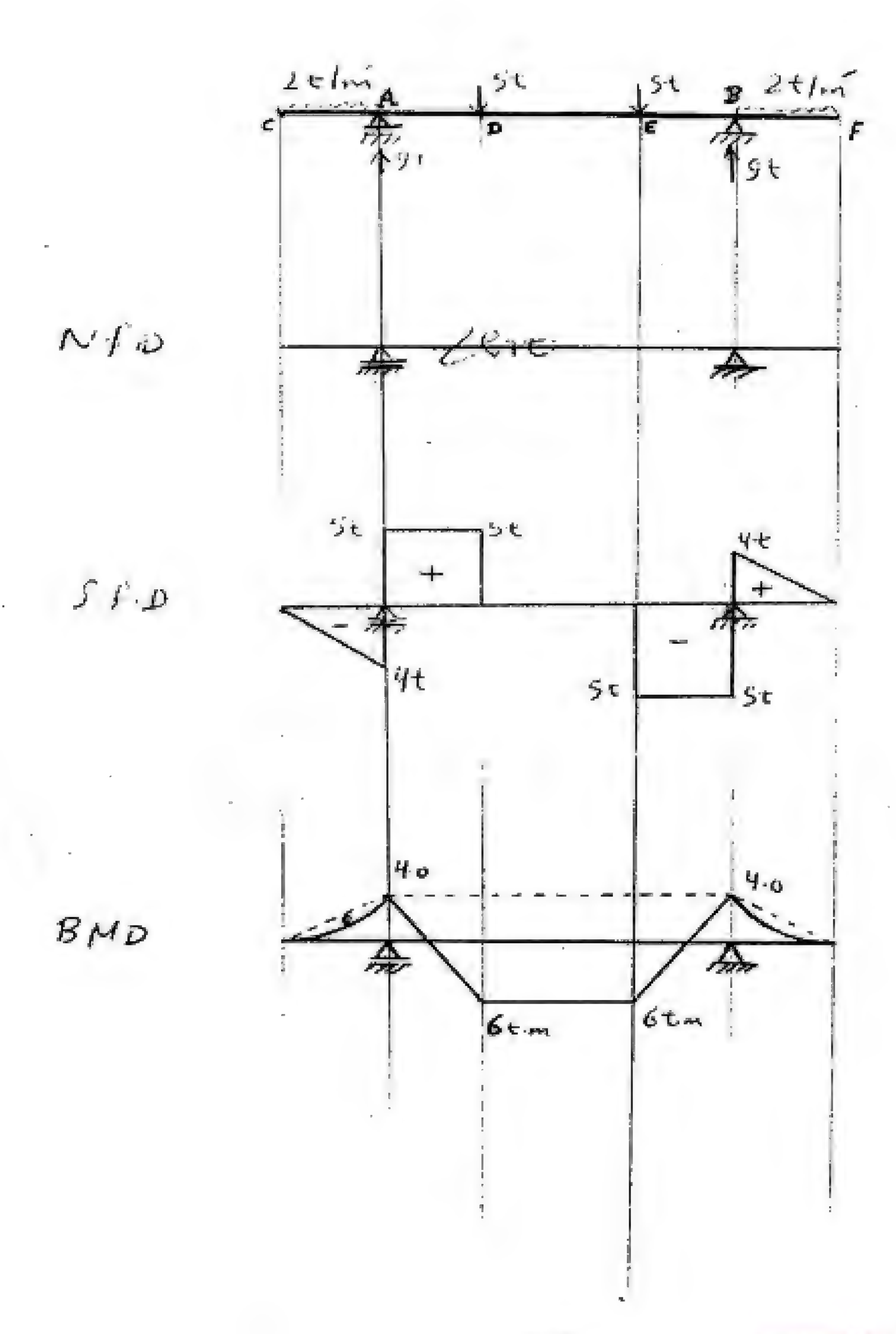
from symmetry

2×2   5   5   2×2

Y_A Y_B X_B

$$\therefore Y_A = Y_B = \frac{(2\times2)\times2+10}{2} = 9 \text{ ton}$$

$\sum X = 0.0 \Rightarrow X_B = 0.0$


2t/m
5t
5t
2t/m
A
B
C
D
E
F
9t
9t
N.F.D
Zero
5t
5t
4t
+
S.F.D
-
4t
-
5t
5t
+
4.0
4.0
BMD
6t.m
6tm

الرسم للأشكال المماثلة

III S.F.D

* at C ⟶ zero
* from (C ⟶ A) [diagram: 4t distributed load] ⟶ قوة 4t لأسفل
لأسفل 4t
لذلك عند A القوة لأسفل ثم 9t لأعلى
لذا تكون 5t
* At A → 9t↑ ∴ Result = −4+9 = 5t (موجب)
* From A ⟶ D no forces ∴ Constant [5t↑]
* at D 5t↓ → 5t↓ & 5t↑ يلاشي → ينعدم
* Constant zero from D → E
* at E 5t↓ → Result (−5) Continue Constant to B
* at B 9t↑ ∴ Result (4t↑)
* from B → F uniform 2t/m [diagram]

∴ Closed zero at (F)

2 B.M.D

* at C ⟶ zero (لا توجد قوى على يمينها لا يوجد عزم
  عزم الأن مثل وجود عزم مركز
  المعطى M)

* at A ⟵ $M_A = 4 \times 1 = 4$ t.m

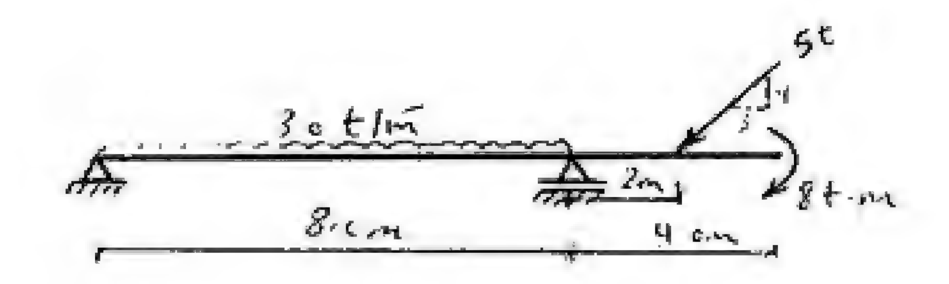
* at D ⟶ $M_D = 4\times3 + 9\times2$
  $= 12 + 18 = 6$

* at L (from Right) such as M_D

and it on at B S F

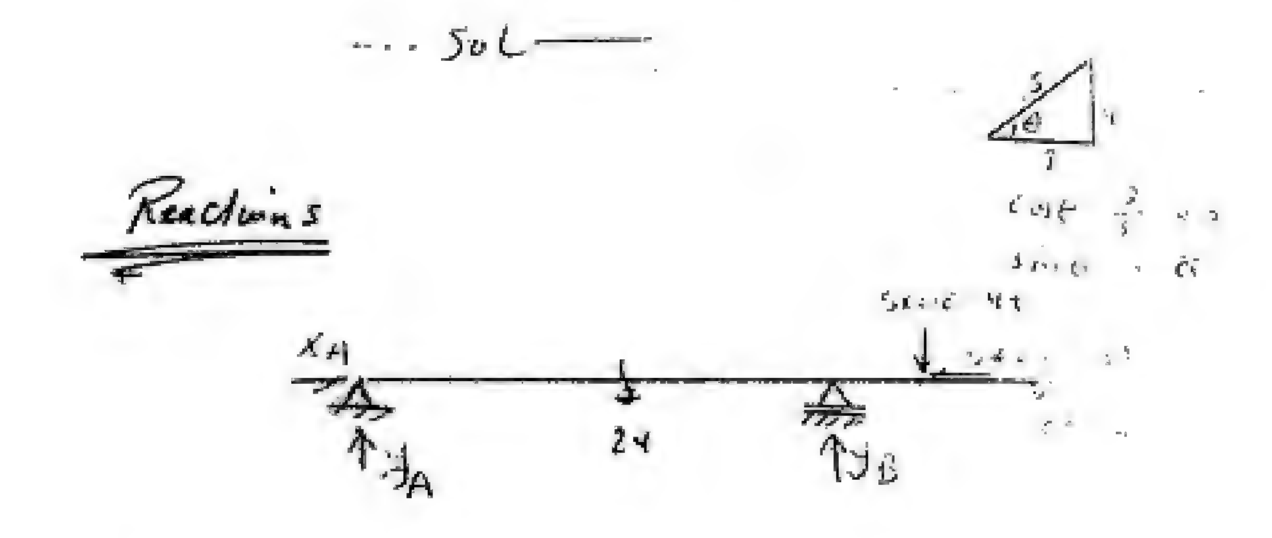
$\frac{wL^2}{8} = \frac{2\times2^2}{8} = 1$





* draw N.F.D, S.F.D and B.M.D

... Sol



$\Sigma X = 0.0 \Rightarrow X_A = 3t$

$\Sigma M_A = 0.0$

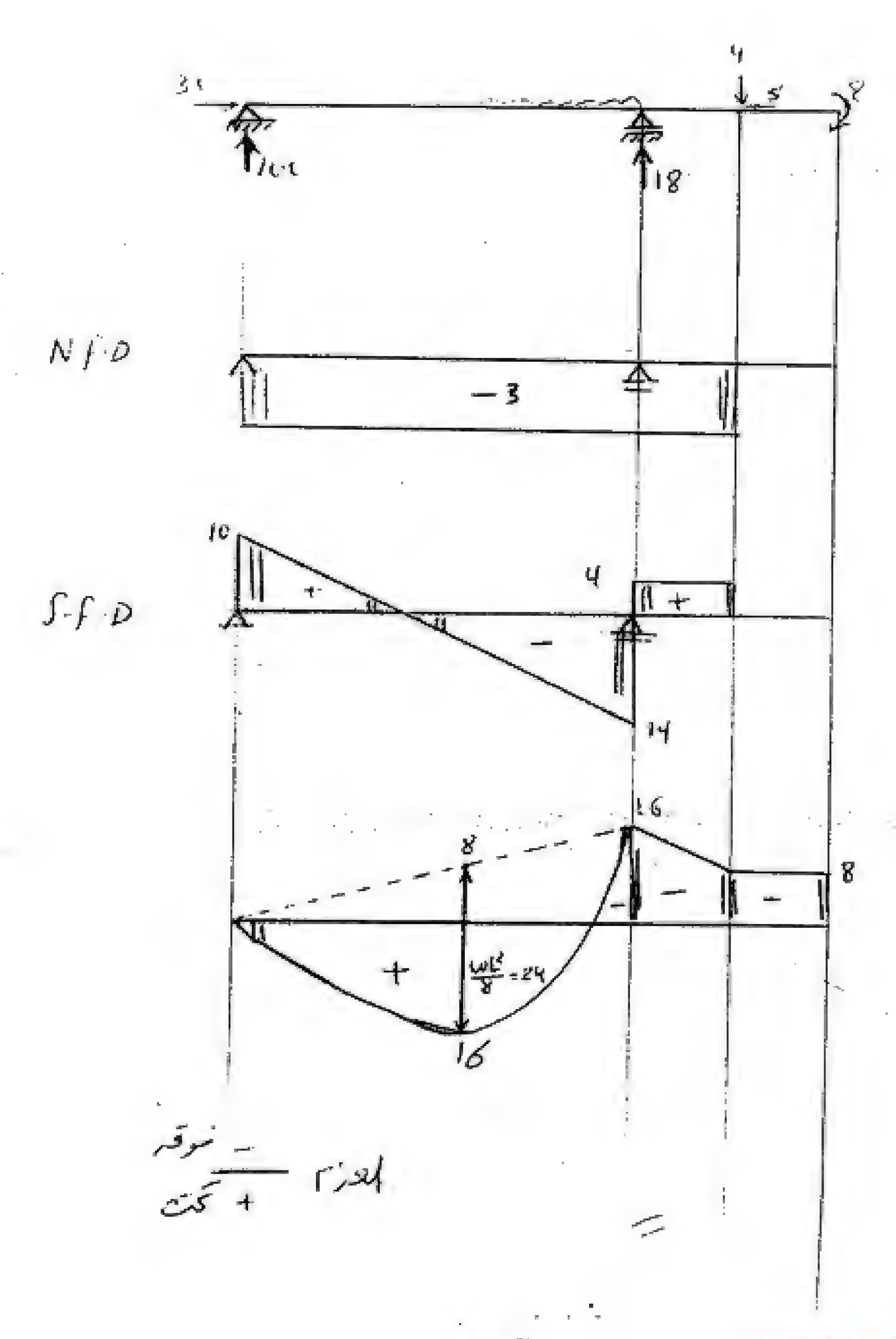
$\Rightarrow 24 * 4 - Y_B * 8 + 4 * 10 + 8 = 0.0$

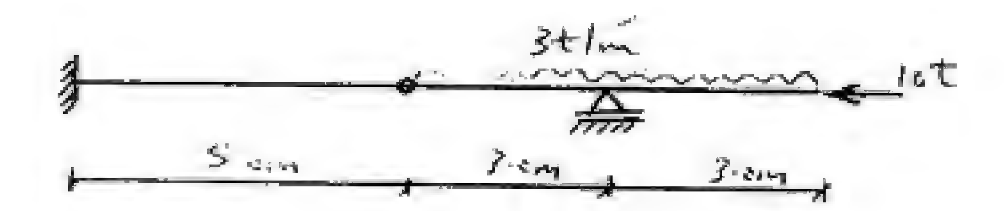
$\Rightarrow Y_B = 18$ ton

$\Sigma Y = 0.0$

$\Rightarrow Y_A = 10$ ton




N.F.D
-3
S.F.D
10
+
4
+
-
14
16
8
8
-
-
-
$\frac{wL^2}{8}=24$
+
16
- فوق
+ تحت
العزم



draw N.F.D, S.F.D and B.M.D

— sol —

A B C D

X_B 18 10

Y_B Y_C

M_A

X_A Y_B X_B

Y_A

<u>upper part</u>

$\Sigma X = 0.0 \Rightarrow X_B = 10\,t$

$\Sigma M_B = 0.0 \Rightarrow 18 * 3 - Y_C * 3 = 0.0$

$\Rightarrow Y_C = 18$

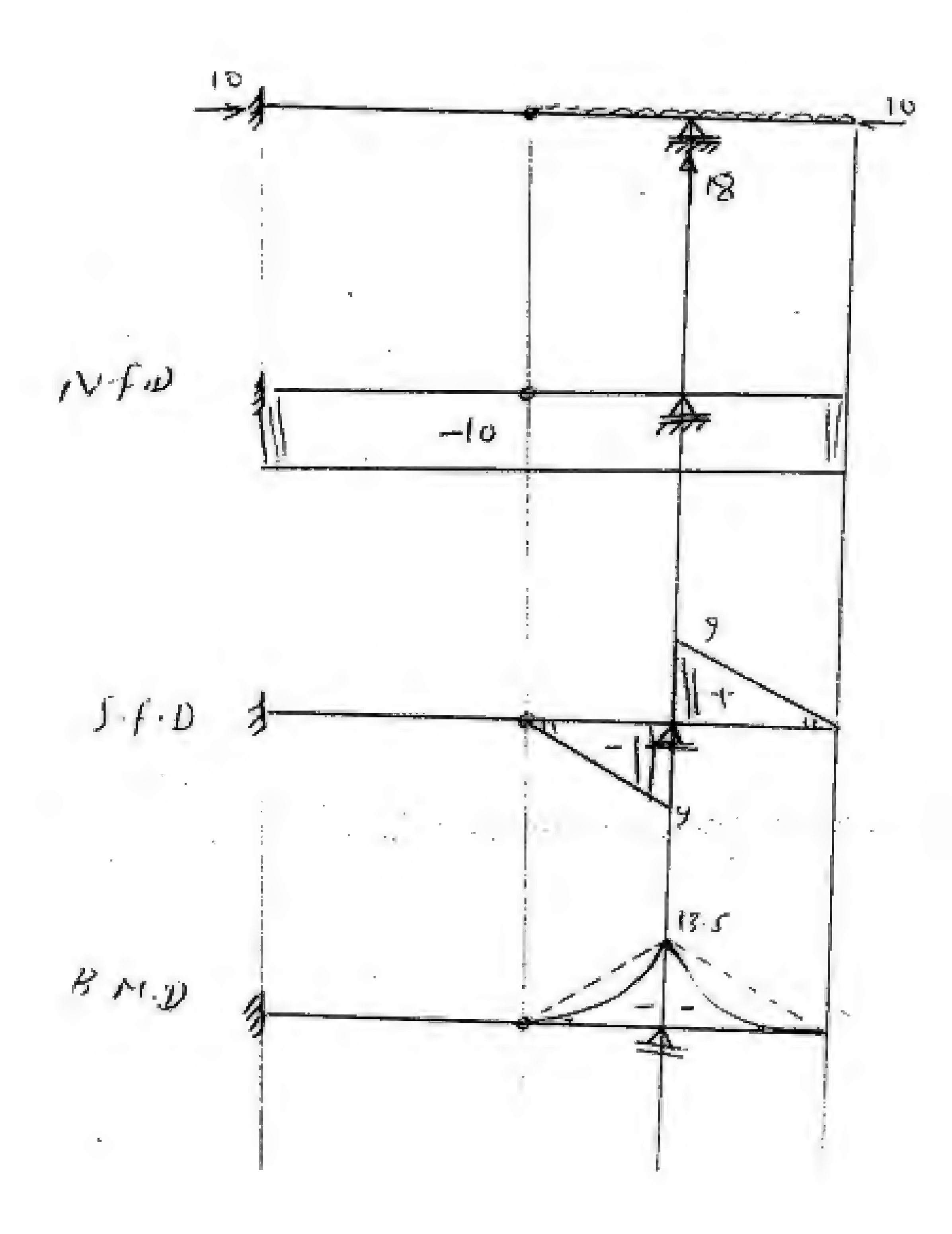
$\Sigma Y = 0.0 \Rightarrow Y_B = 0.0$

<u>lower part</u>

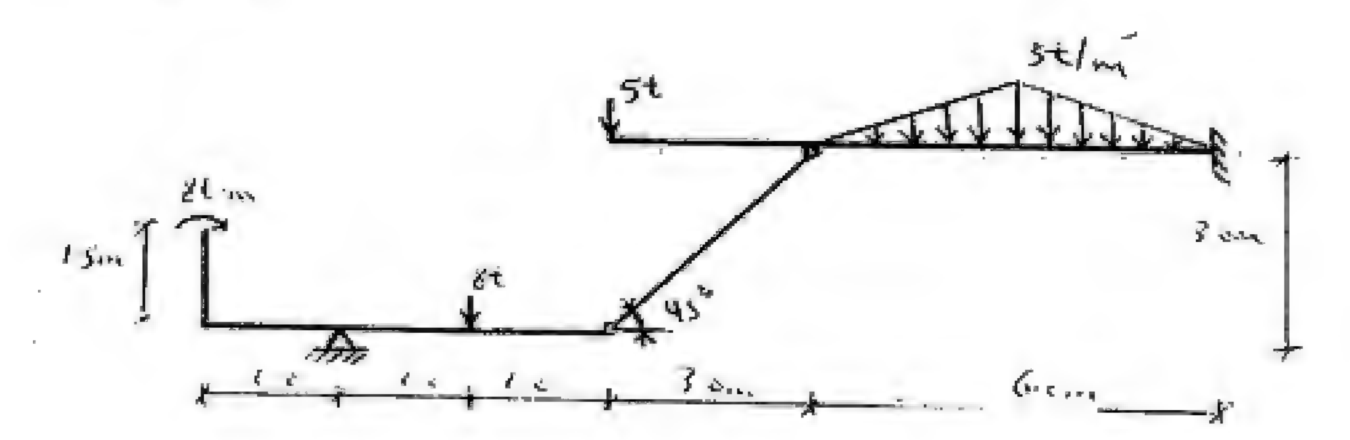
$X_A = 10\,t$

$Y_A = 0.0$

$M_A = 0.0$

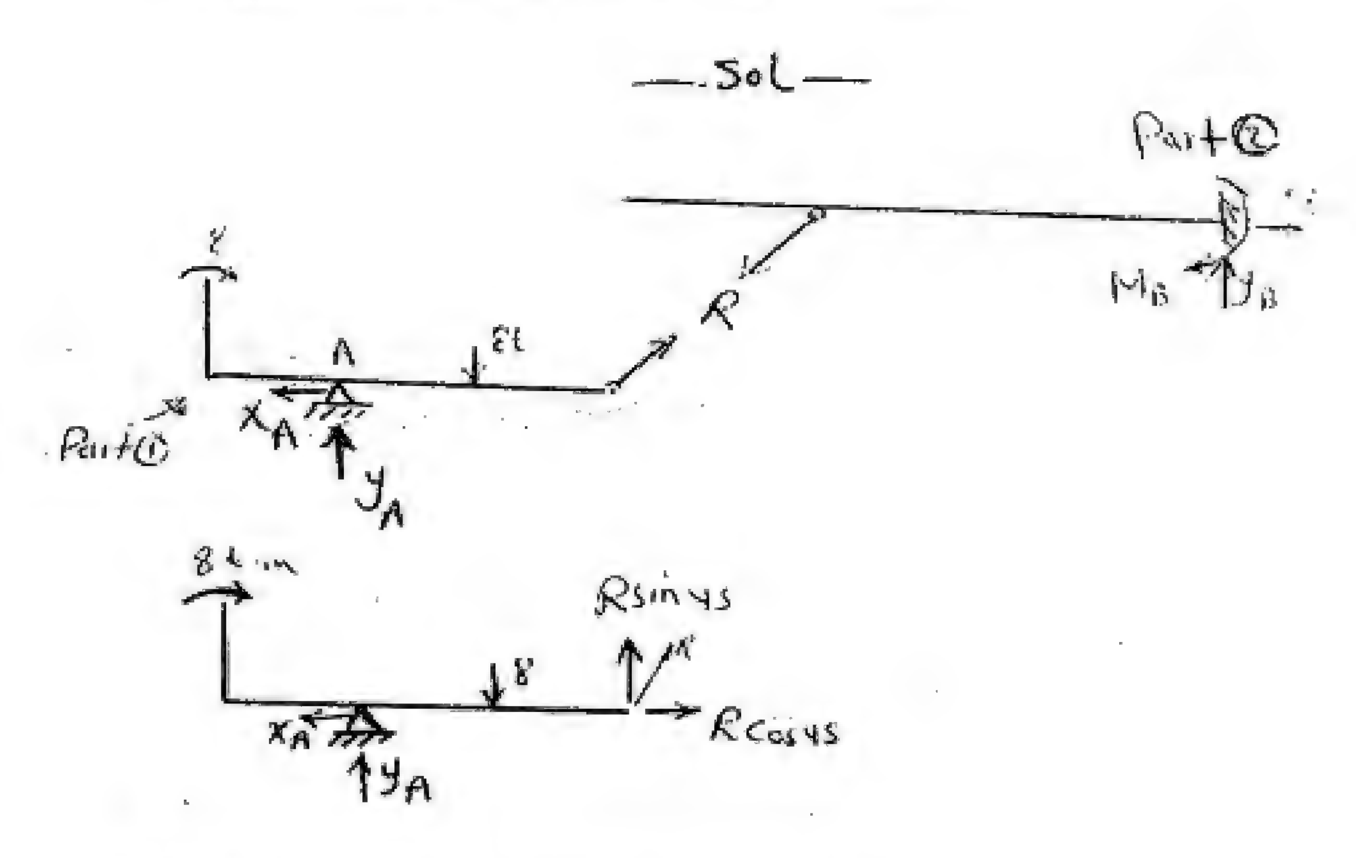

10
10
18
N.F.D
-10
S.F.D
9
9
B.M.D
13.5

Final 2002



draw N.F.D's S.F.D and B.M.D

—Sol—



$* \sum M_A = 0.0 \Rightarrow 8 + 8*2 - R\sin 45 * 4.0 = 0.0$

$\therefore R = 8.5$ ton

* $\Sigma X = 0.0$

$\Rightarrow X_A = R \cos 45 = 6.0$ ton

* $\Sigma y = 0.0$

$\Rightarrow y_A = 8 - 6 = 2t$

Part ②



* $\Sigma y = 0.0$

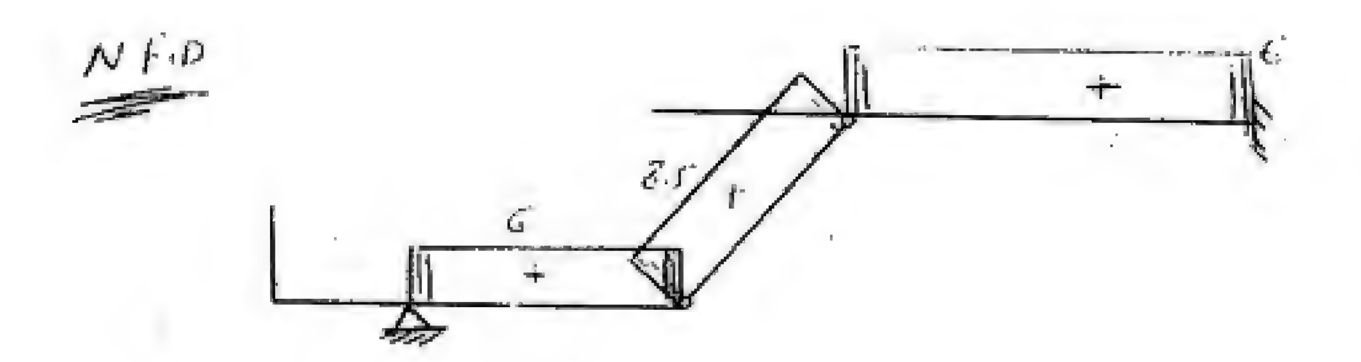
$\Rightarrow y_B = 20$ ton

* $\Sigma X = 0.0$

$\Rightarrow X_B = 6$ ton

* $\Sigma M = 0.0$

$\therefore M_B = 9 * 3 + 6 * 6 + 5 * 9 = 108$ t.m



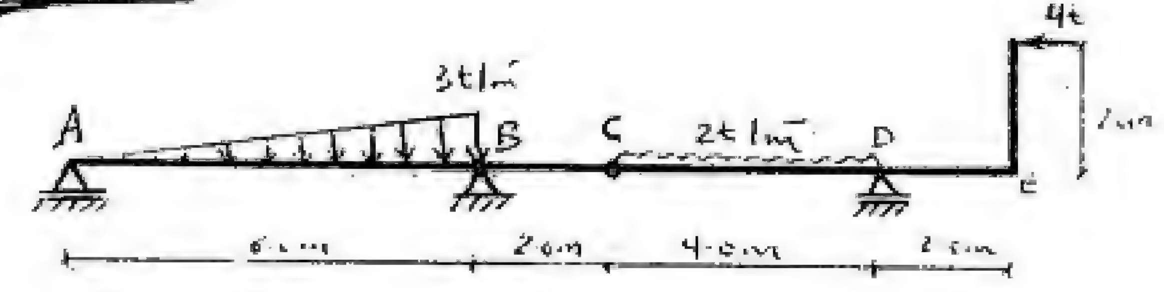
S.f.D

5
-
11
-
20
2
6

B.M.D

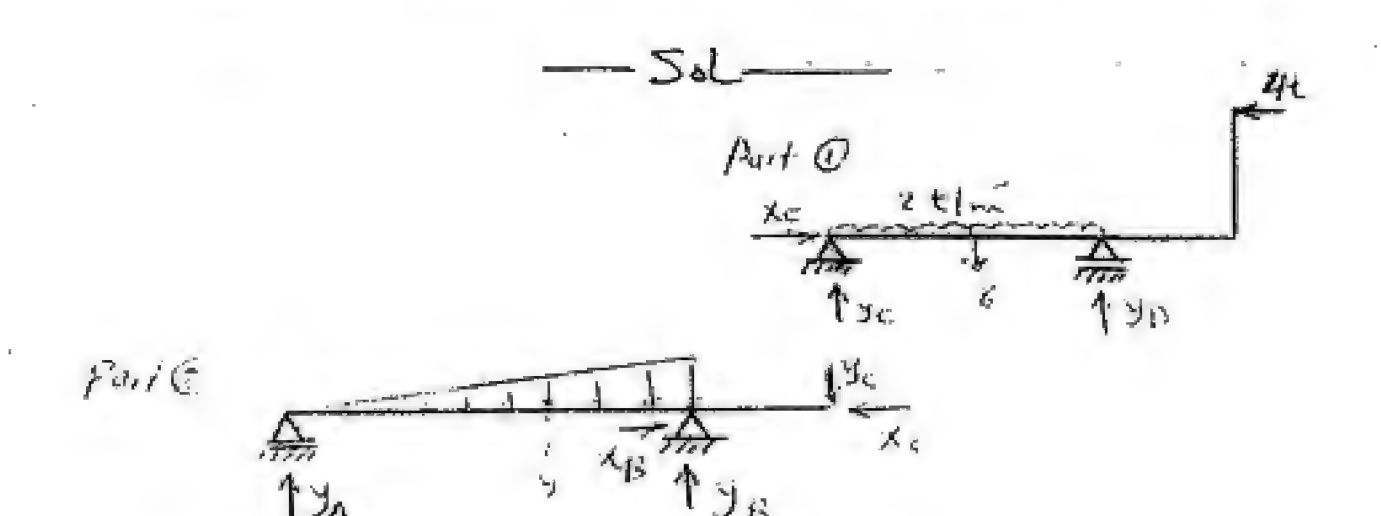
108
21.5
15
32.5
-
K
+
8
4
12

mid term 2000



draw N.F.D , S.F.D and B.M.D

— Sol —



Part ①

* $\Sigma X = 0 \Rightarrow X_c = 4.0$ ton

* $\Sigma M_c = 0$

$8 \times 2 - 4 \times 2 = Y_D \times 4 \Rightarrow Y_D = 2$ ton

* $\Sigma Y = 0$

$\Rightarrow Y_c = 6$ ton.

part ②

$\cdot \sum X = 0 \quad \Rightarrow \quad X_B = 4 \text{ ton}$

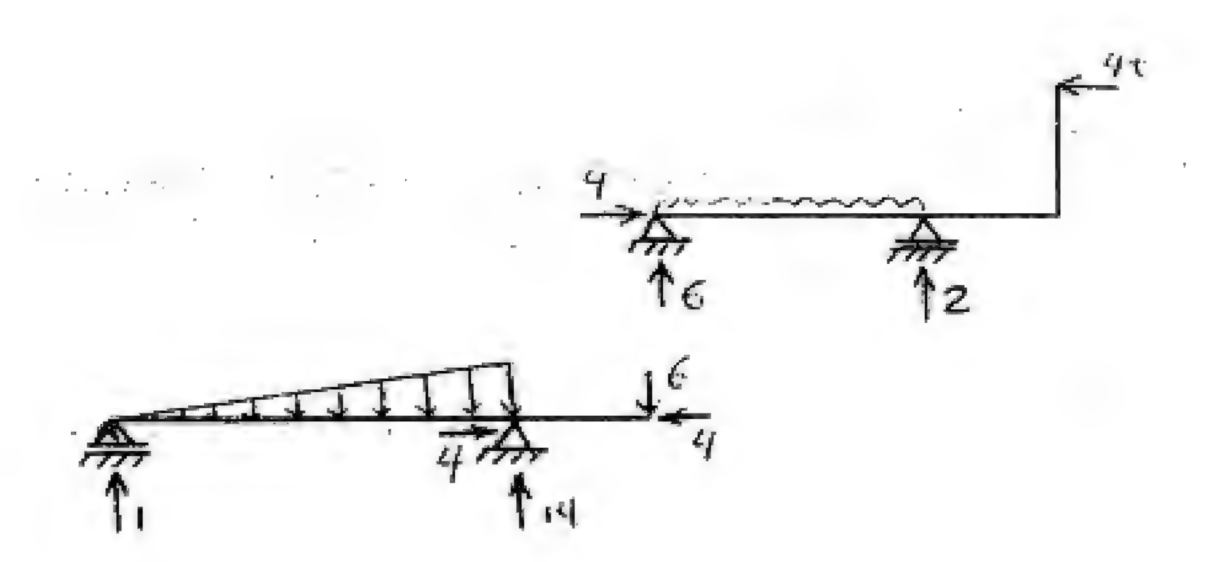
$\cdot \sum M_A = 0$

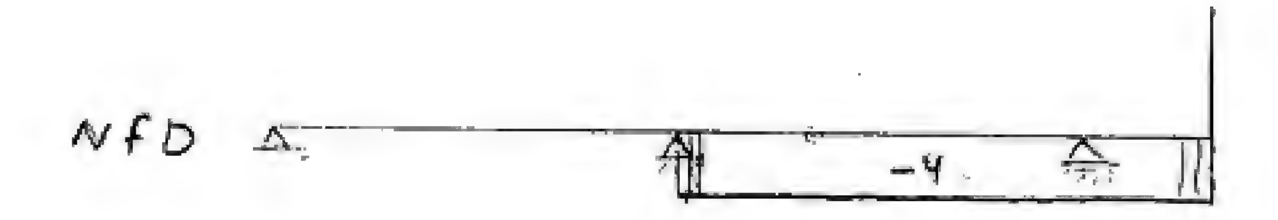
$$9 * 4 + 6 * 8 = Y_B * 6$$

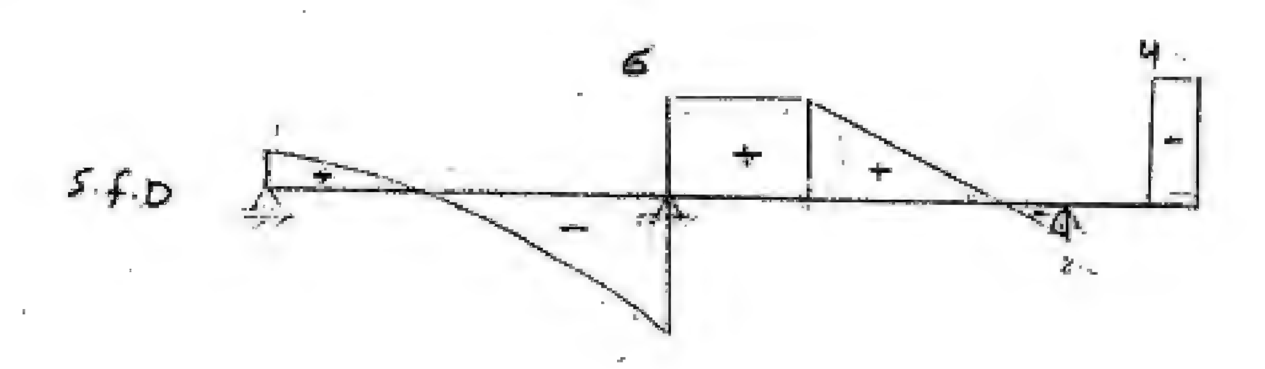
$$\therefore Y_B = 14 \text{ ton}$$

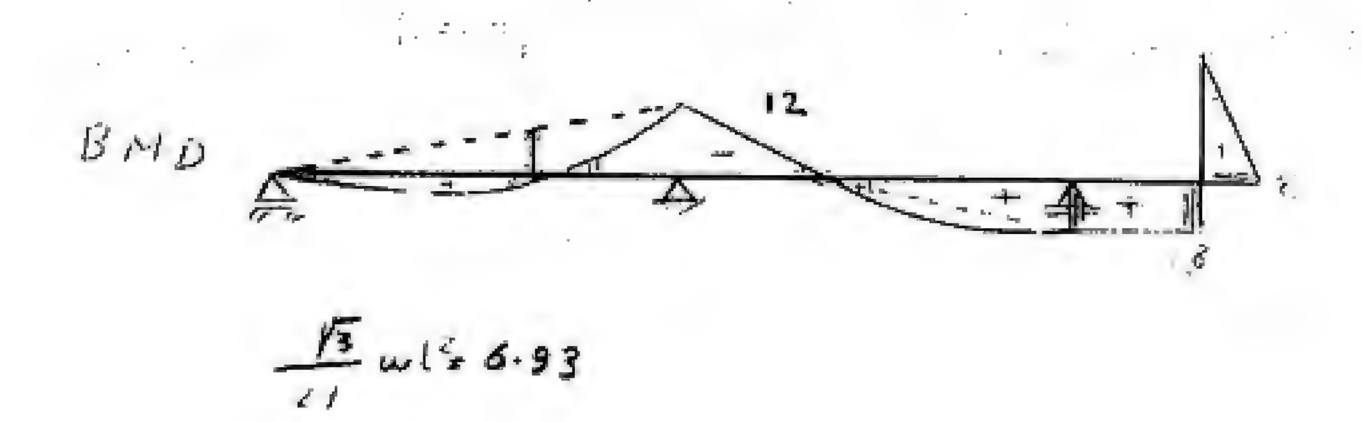
$\cdot \sum Y = 0$

$$\therefore Y_A = 9 + 6 - 14 = 1 \text{ ton}$$



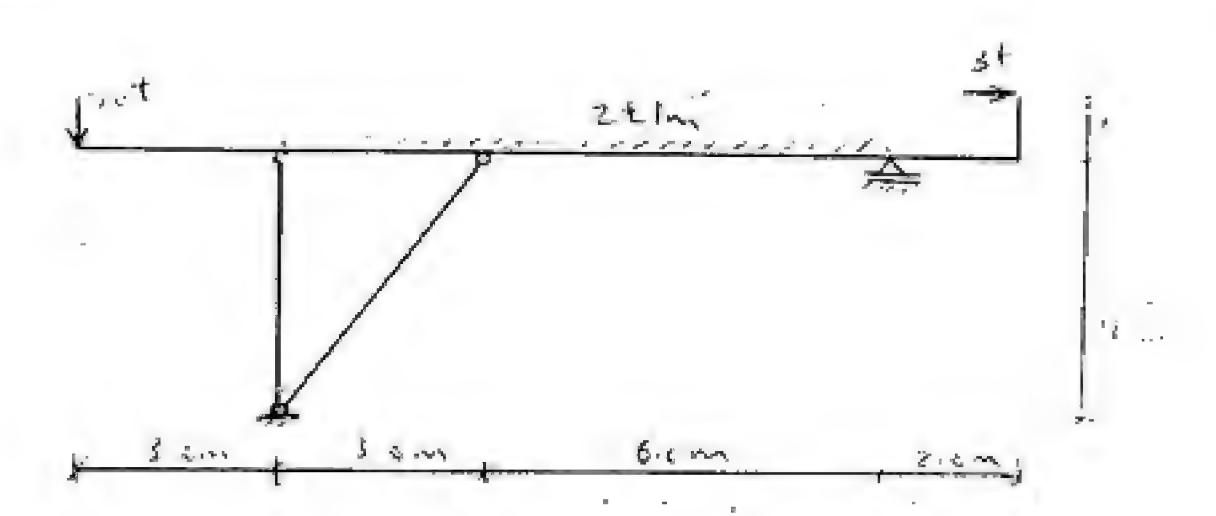






$\frac{\sqrt{3}}{27} wl^2 = 6.93$

mid term
2005



draw N.F.D , S.F.D and B.M.D

— sol —

$0.6 \times R_2 = 5$

$R_2 = 5t$

$\Sigma M_1 = 0$

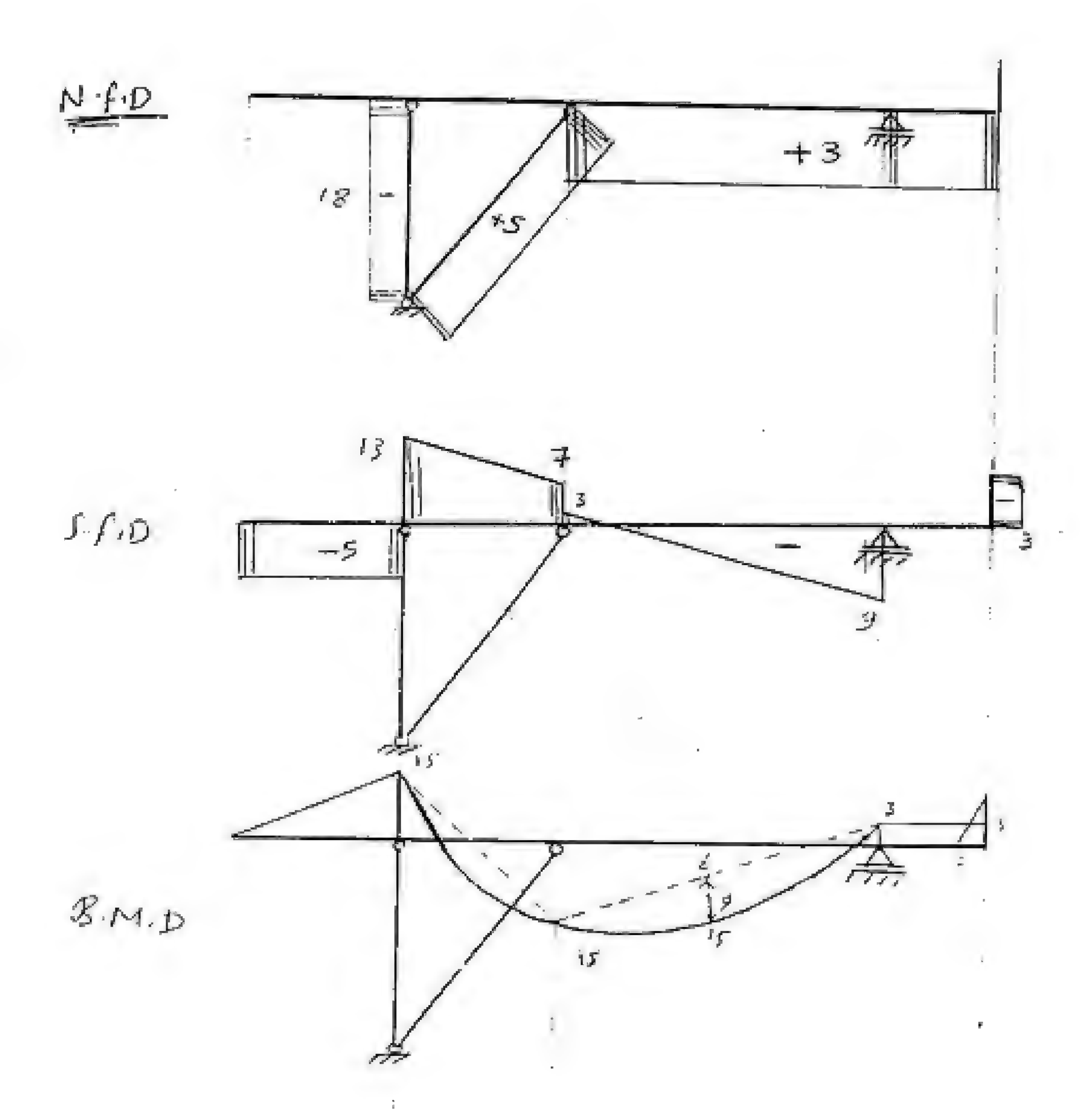
$4 \times 5 + 18 \times 4.5 - 5 \times 3 + 3 \times 1 - R_3 \times 9 = 0$

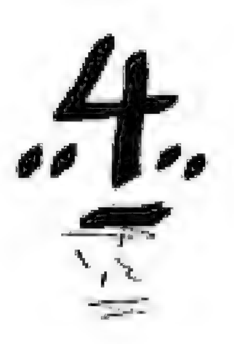
$R_3 = 9.0$ ton

$\Sigma y = 0.0$

$\Rightarrow \quad 5 + 18 + 4 - 9 = R_1$

$R_1 = 18$ ton





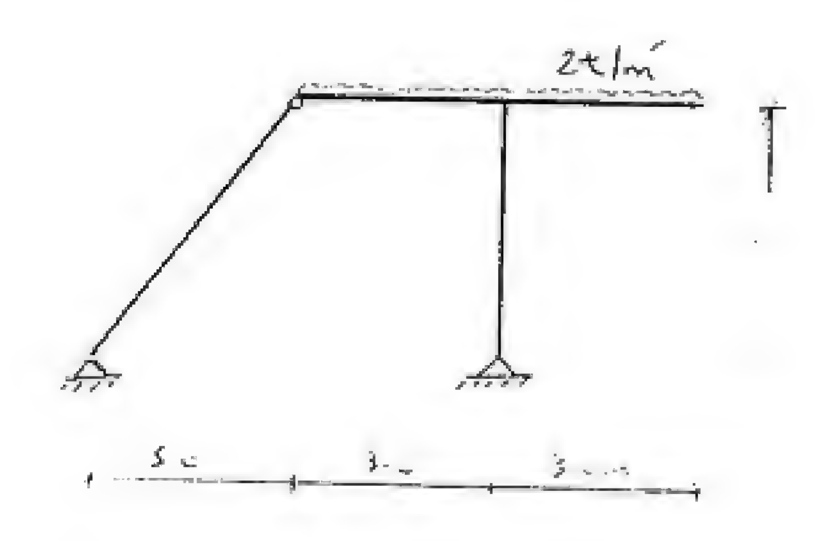
بسم الله الرحمن الرحيم

Frame

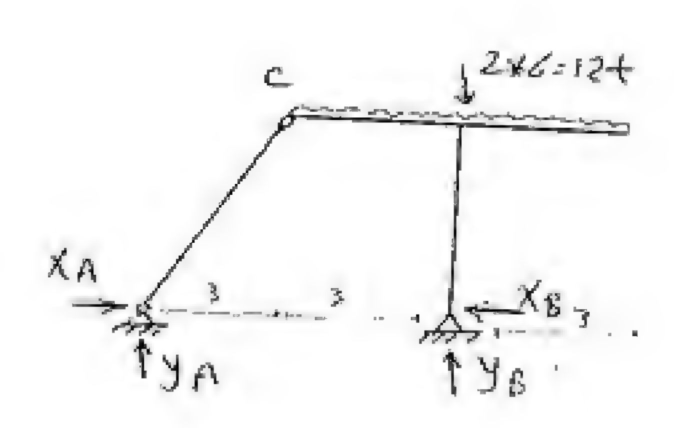
ملاحظة: رؤ كبر سمع frame to beam

mid term 2000

For the following Frame draw B.M.D, N.F.D and S.F.D



Sol



* $\Sigma M_A = 0.0$

$\Rightarrow 12 \times 6 = y_B \times 6$

$y_B = 12$

* $\Sigma y = 0.0$

$\Rightarrow y_A = 0.0$

$* \sum M_{c\ left} = 0.0$

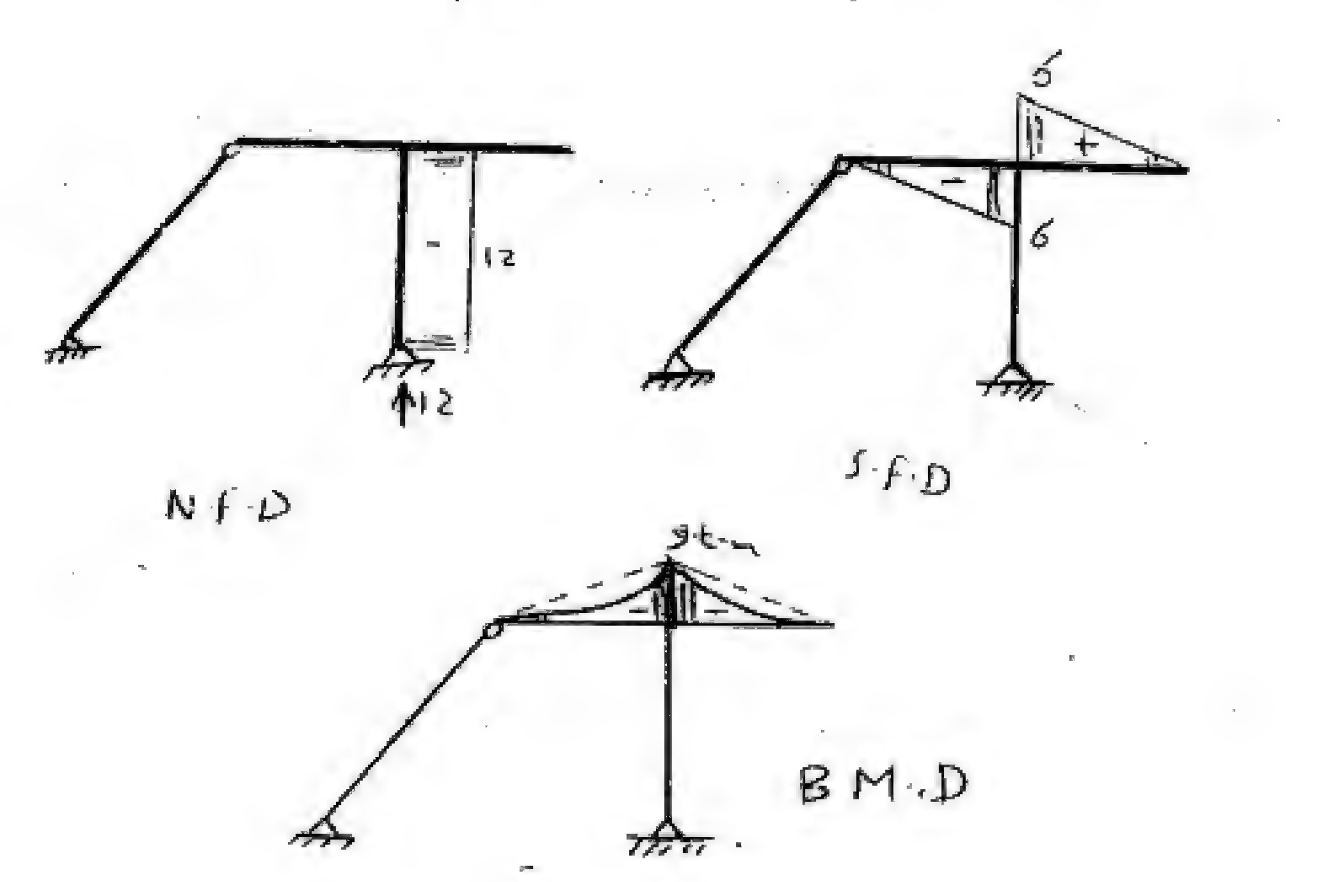
$$y_A * 3 = x_A * 4$$

$$y_A = \dots \Rightarrow x_A = 0.0$$

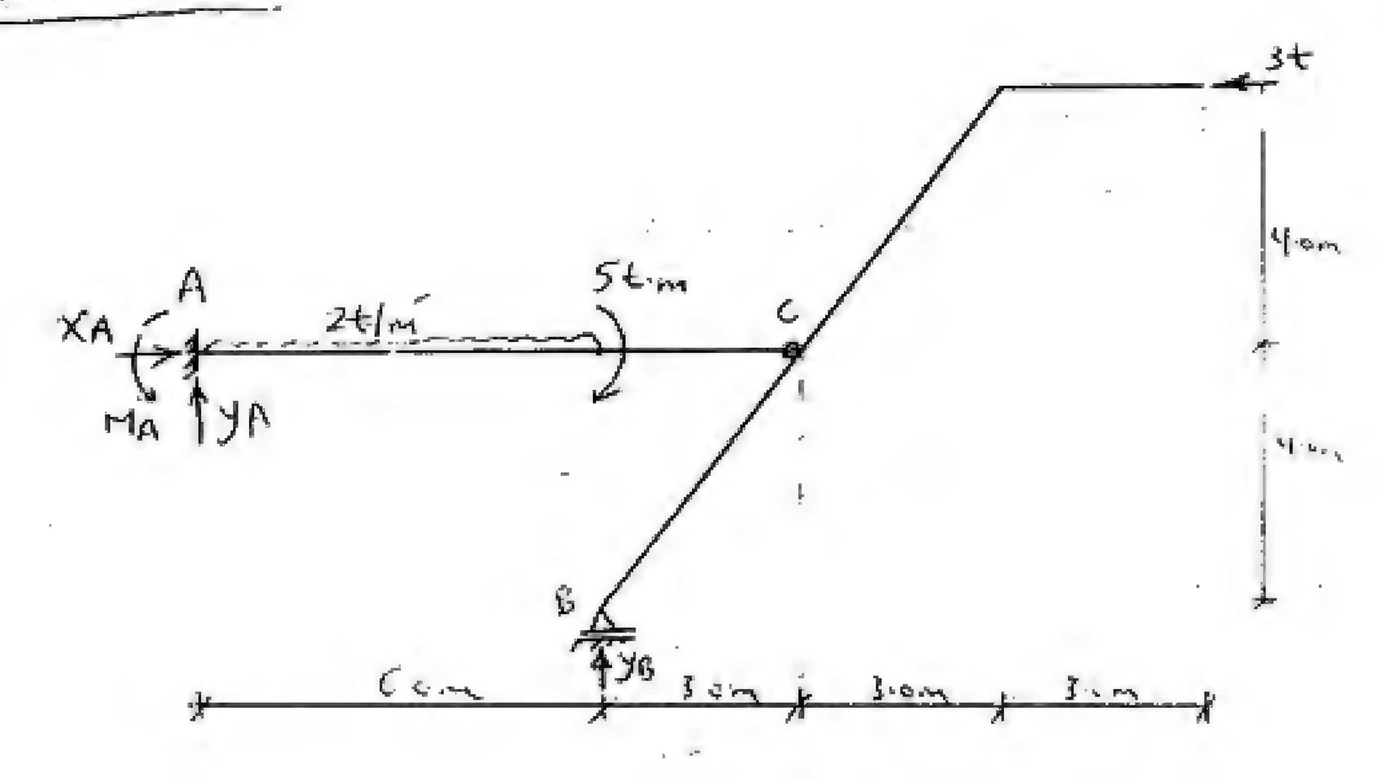
$* \sum X = 0.0$

$$\Rightarrow x_B = 0.0$$

* ملحوظة ⇐ [illegible] AC ⇐ Link member [illegible]
إلا قوة واحدة في اتجاهه



midterm 2005



- Sol -

$\Rightarrow \sum X = 0$

$\Rightarrow X_A = 3.2$ ton

$\Rightarrow \sum M_A = 0.0$

$-M_A - 2 * 6 * 3 + 5 - 3 * 4 - Y_B * 6 = 0.0$

$\therefore Y_B * 6 + M_A = 29 \longrightarrow (1)$

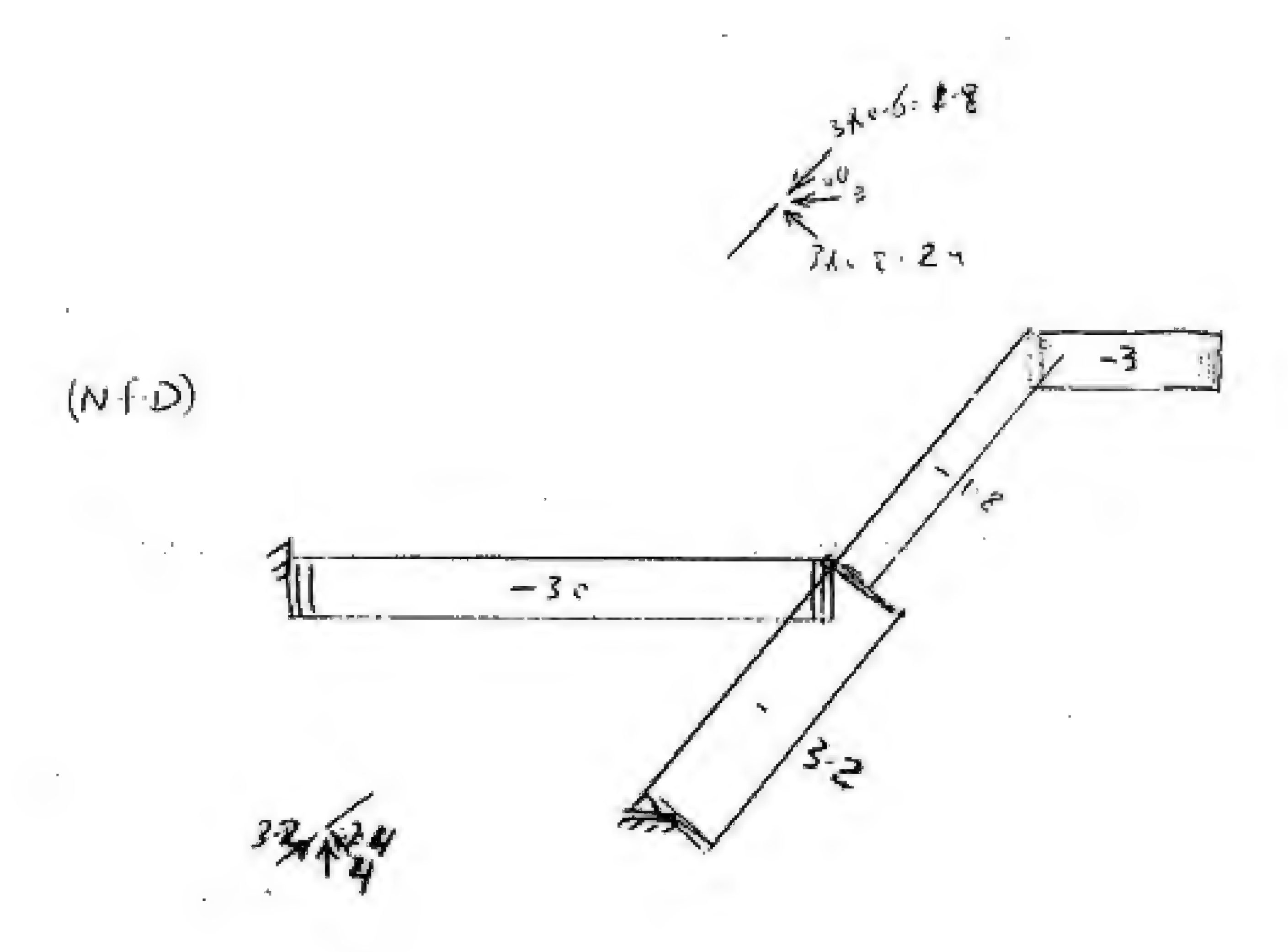
$\Rightarrow M_{C\,Right} = 0 \Rightarrow 3 * 4 = Y_B * 3$

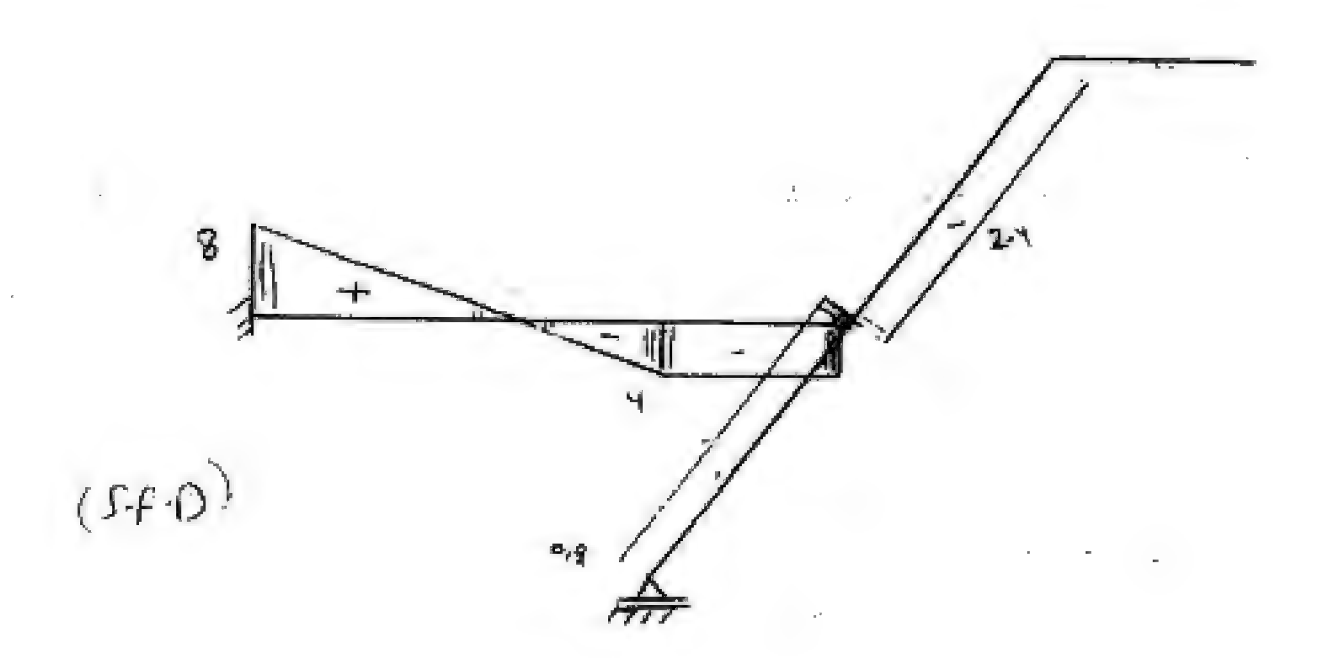
$\Rightarrow Y_B = 4$

$\therefore M_A = 3\,t.m$

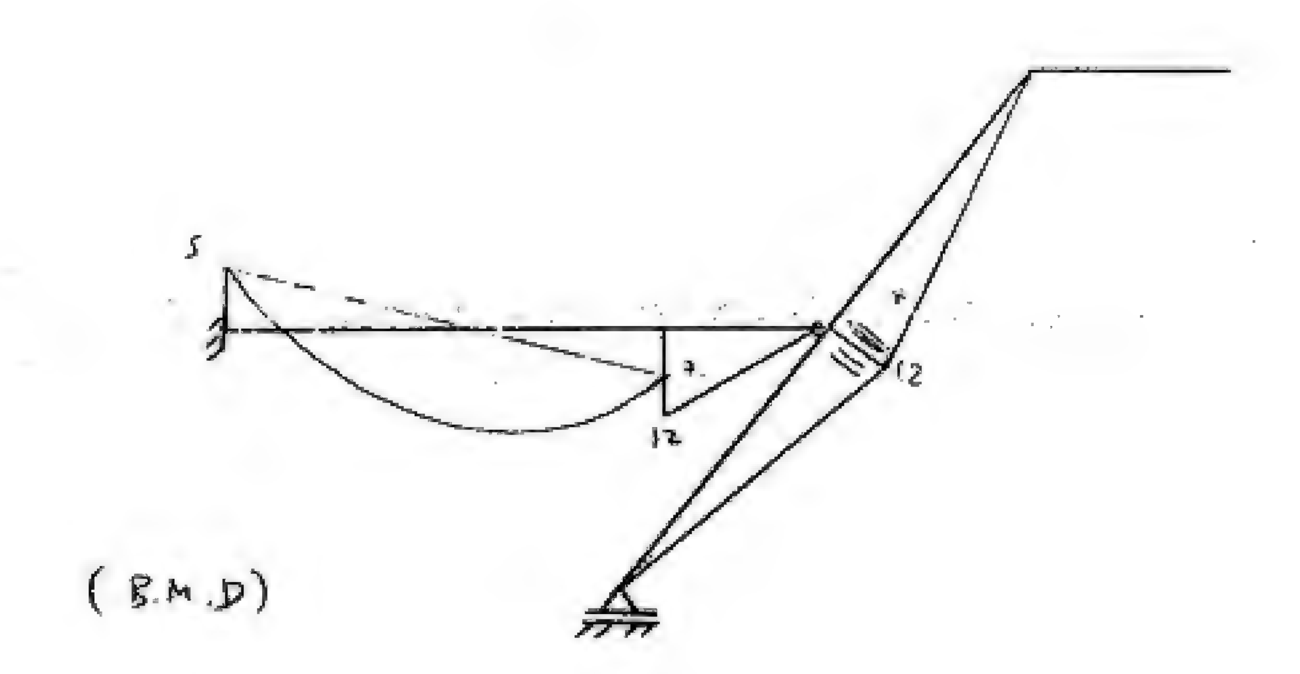
$\Rightarrow \Sigma y = 0.0$

$\Rightarrow y_A = 12 - 4.0 = 8\,t.n.$





8
+
-
-
-
4
2.4
(S.F.D)
0.8



5
7
12
12
+
(B.M.D)

Final 2001

2t/m'

6t

A

C

B

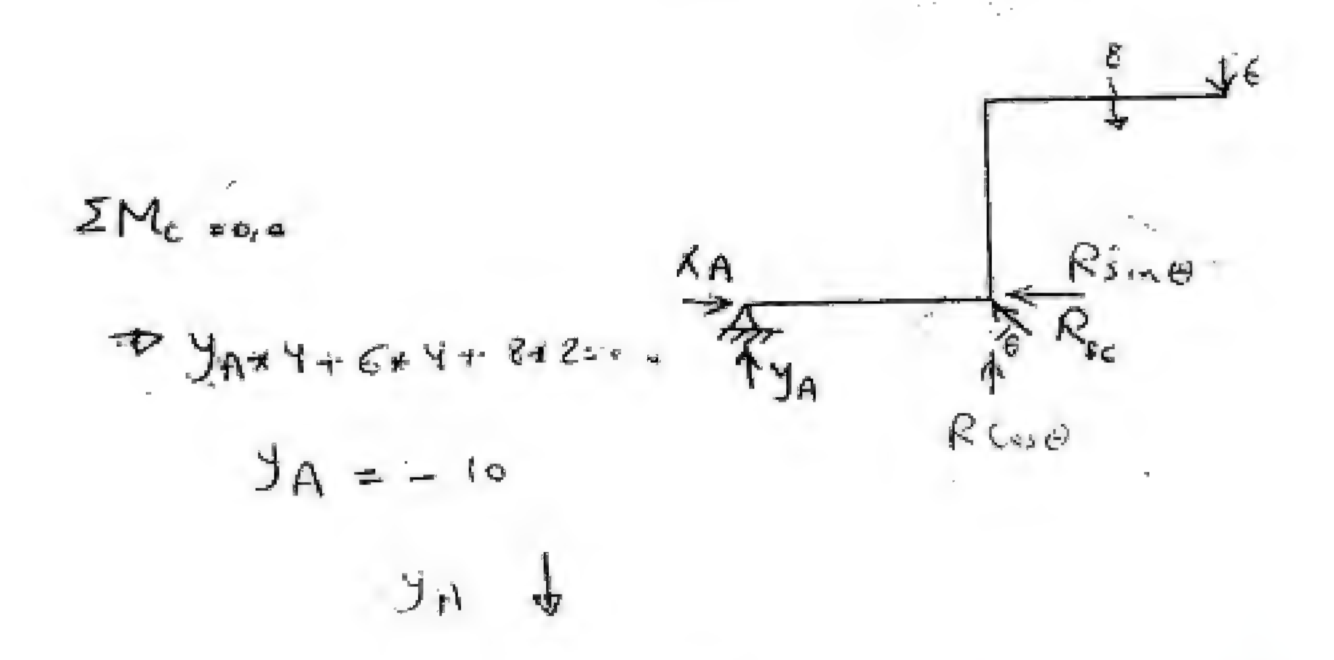
3.0m

3.0m

4.0m

4.0m

— Sol —



$\Sigma M_c = 0.0$

$\Rightarrow y_A * 4 + 6 * 4 + 8 * 2 = 0$

$y_A = -10$

$y_A \downarrow$

$* \sum Y = 0.0$

$10 + 6 + 8 = R\cos\theta$

$24 = R \times 0.6$

$\therefore R = 40 \text{ ton}$

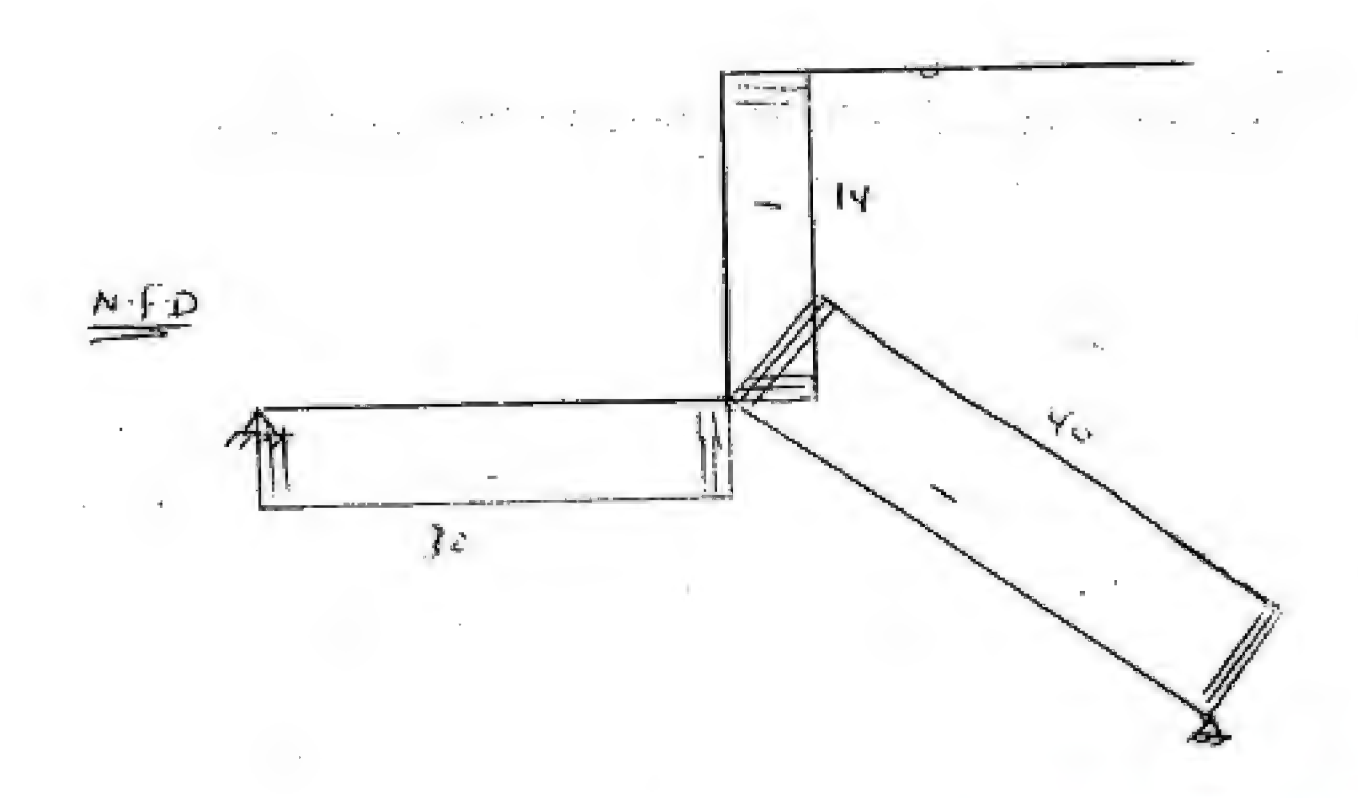
$\cos\theta = 0.6$

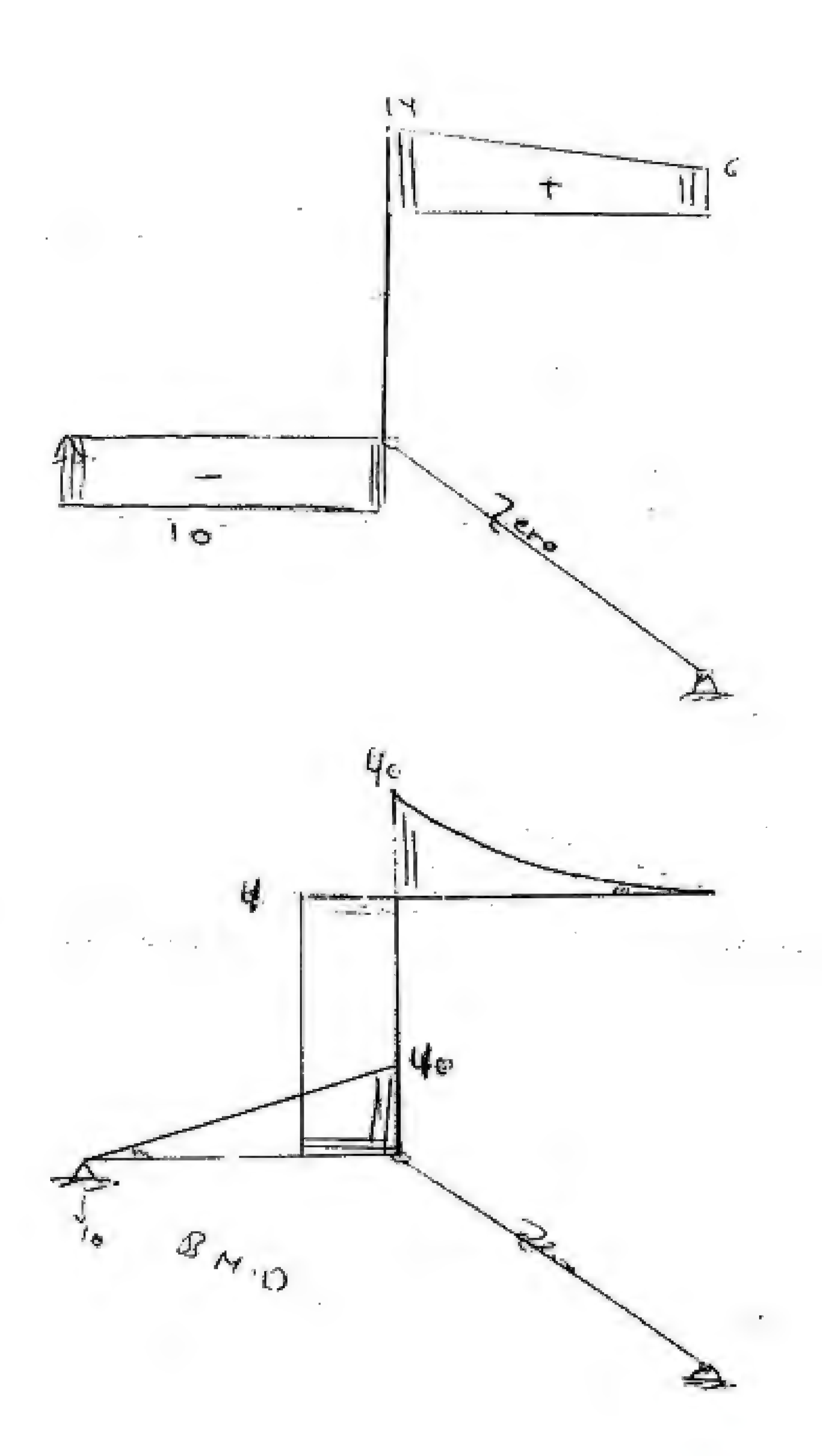
$\sin\theta = 0.8$

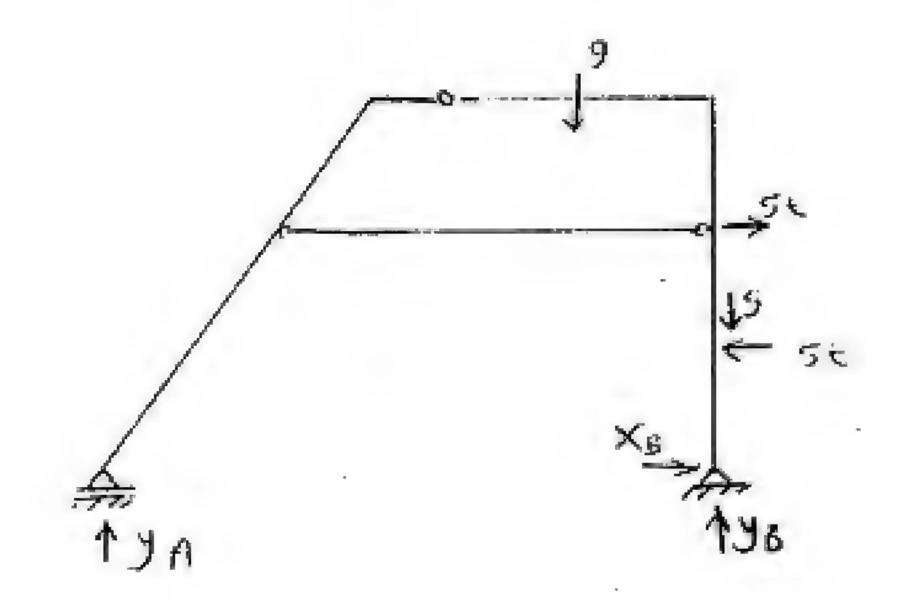
$* \sum X = 0.0$

$R \times 0.8 = X_A$

$X_A = 32 \text{ ton}$




14
6
+
-
10
Zero
40
4
40
B.M.D



* $\Sigma X = 0.0$

$\Rightarrow X_B = 0.0$

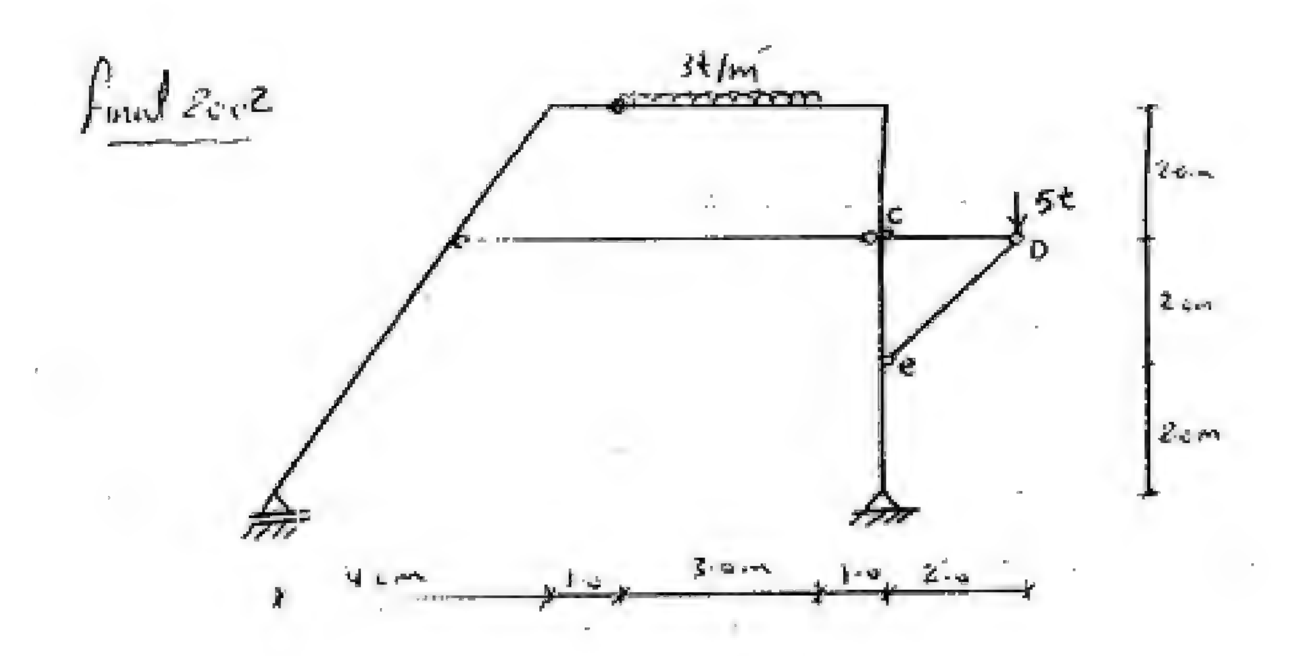
* $\Sigma M_A = 0.0$

$5*9 + 9*6.5 + 5*4 - 5*2 = y_B * 9$

$\therefore y_B = 12.611$ ton

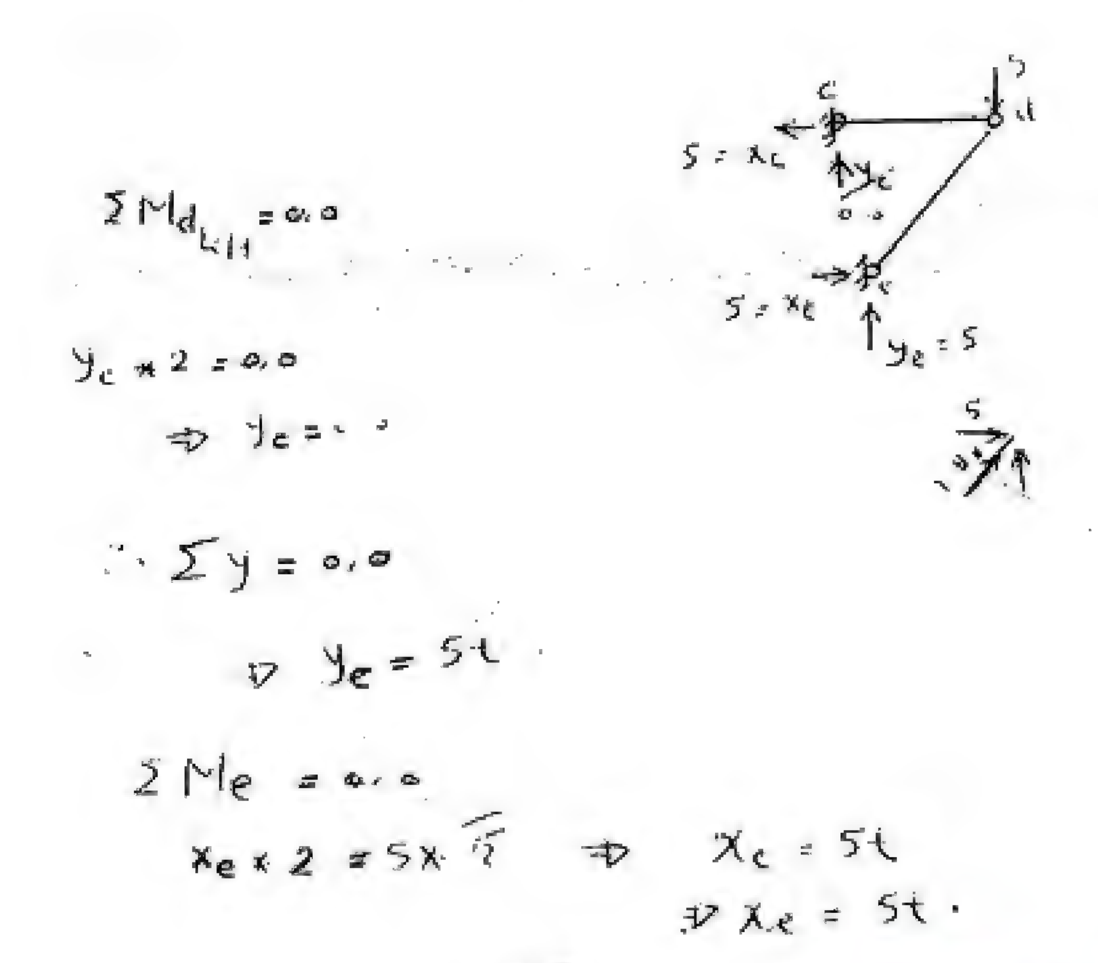
* $\Sigma y = 0.0$

$y_A = 1.389$ ton.

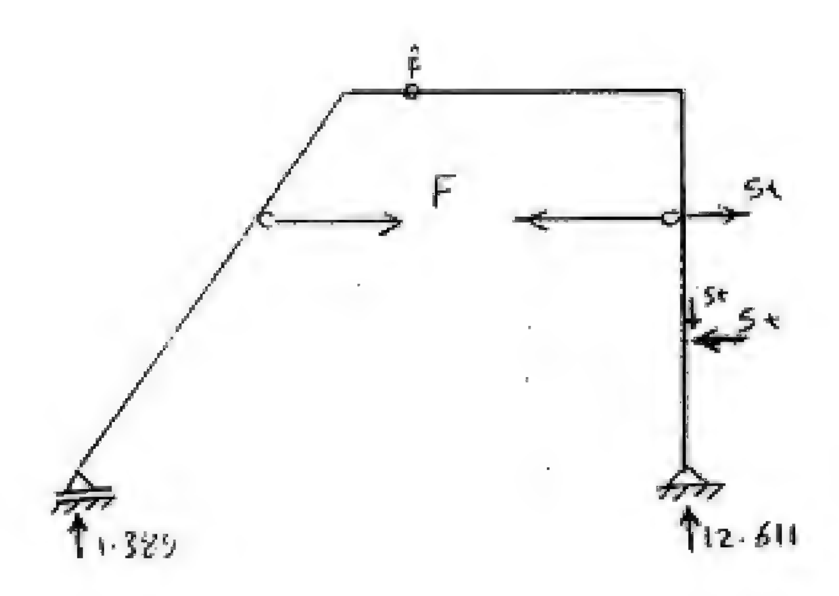


Final 2002
3t/m'
5t
c
D
e
2.0m
2.0m
2.0m
4.0m
1.0
3.0m
1.0
2.0

- S.C.L -



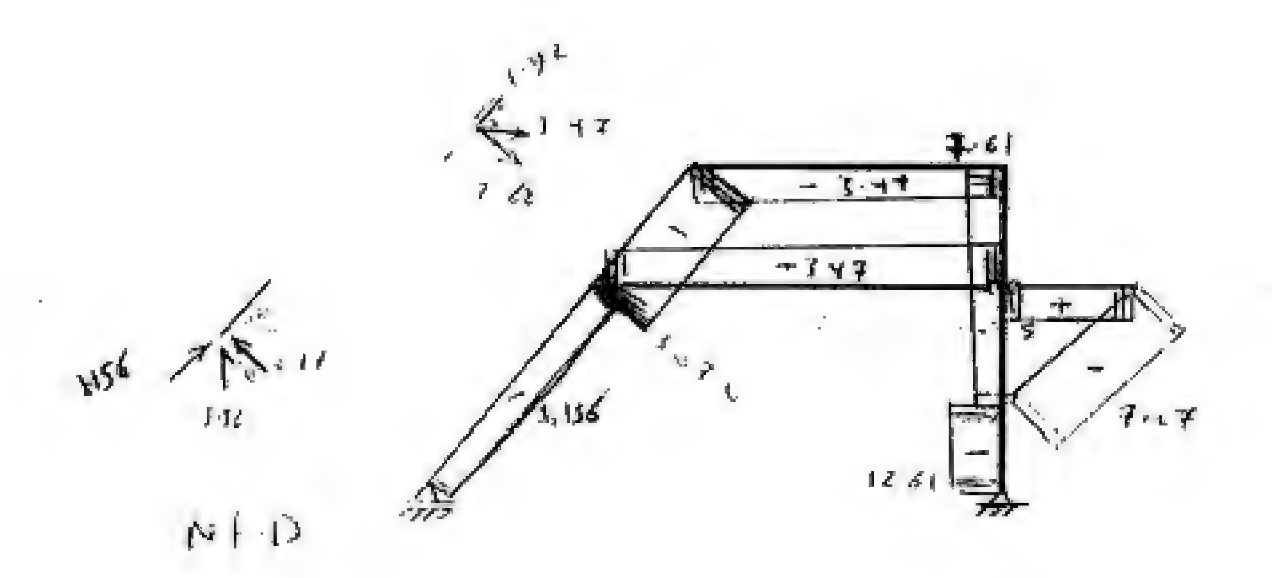
5
c
d
5 = Xc
Yc
0.0
5 = Xe
Ye = 5
ΣMd(Lft) = 0.0
Yc * 2 = 0.0
⇒ Yc = 0.0
∴ ΣY = 0.0
⇒ Ye = 5t
ΣMe = 0.0
Xe * 2 = 5 * 2
⇒ Xc = 5t
⇒ Xe = 5t



$$\Sigma M_{F_{left}} = 0.0$$

$$F \times 2 = 1.329 \times 5$$

$$\Rightarrow F = 3.42 \text{ ton.}$$



1.324

3.47

Zero

2.11

S.F.D

1.324

1.324

16.93

4.33

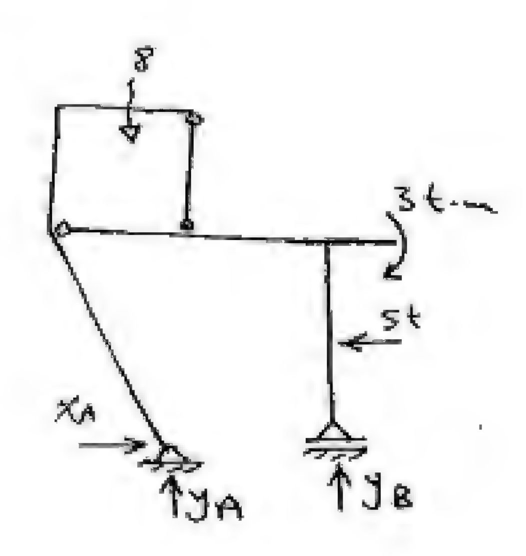
10

B.M.D

final 2004

For the Flollowing Frame draw B.M.D S.F.D, N.F.D

— Sol —



For Reactions

$\Rightarrow \Sigma X = 0.0$

$$X_A = 5.0 \text{ ton}$$

$\Rightarrow \Sigma M_A = 0.0$

$$-8 * 2 + 3 - 5 * 3 - Y_B * 4 = 0.0$$

$$Y_B = -7 \quad \Rightarrow Y_B = \downarrow 7 \text{ ton}$$

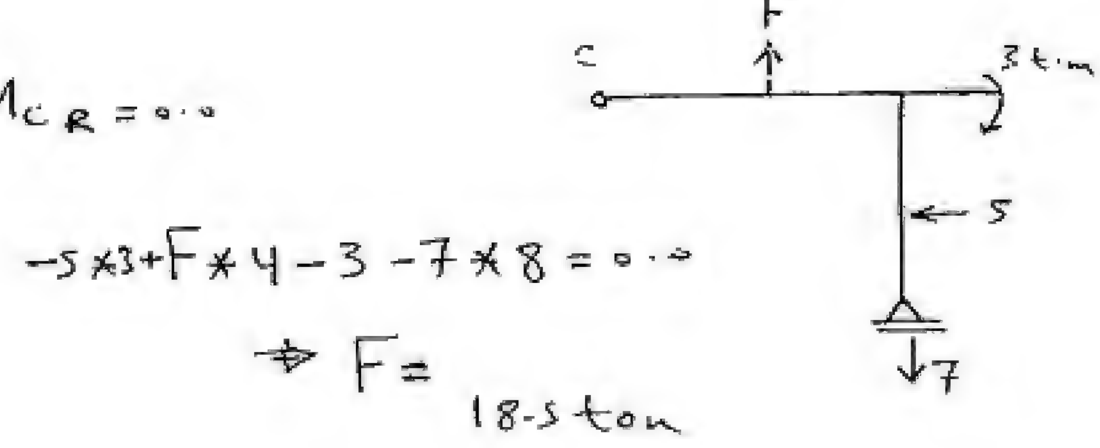
$\Rightarrow \Sigma Y = 0.0$

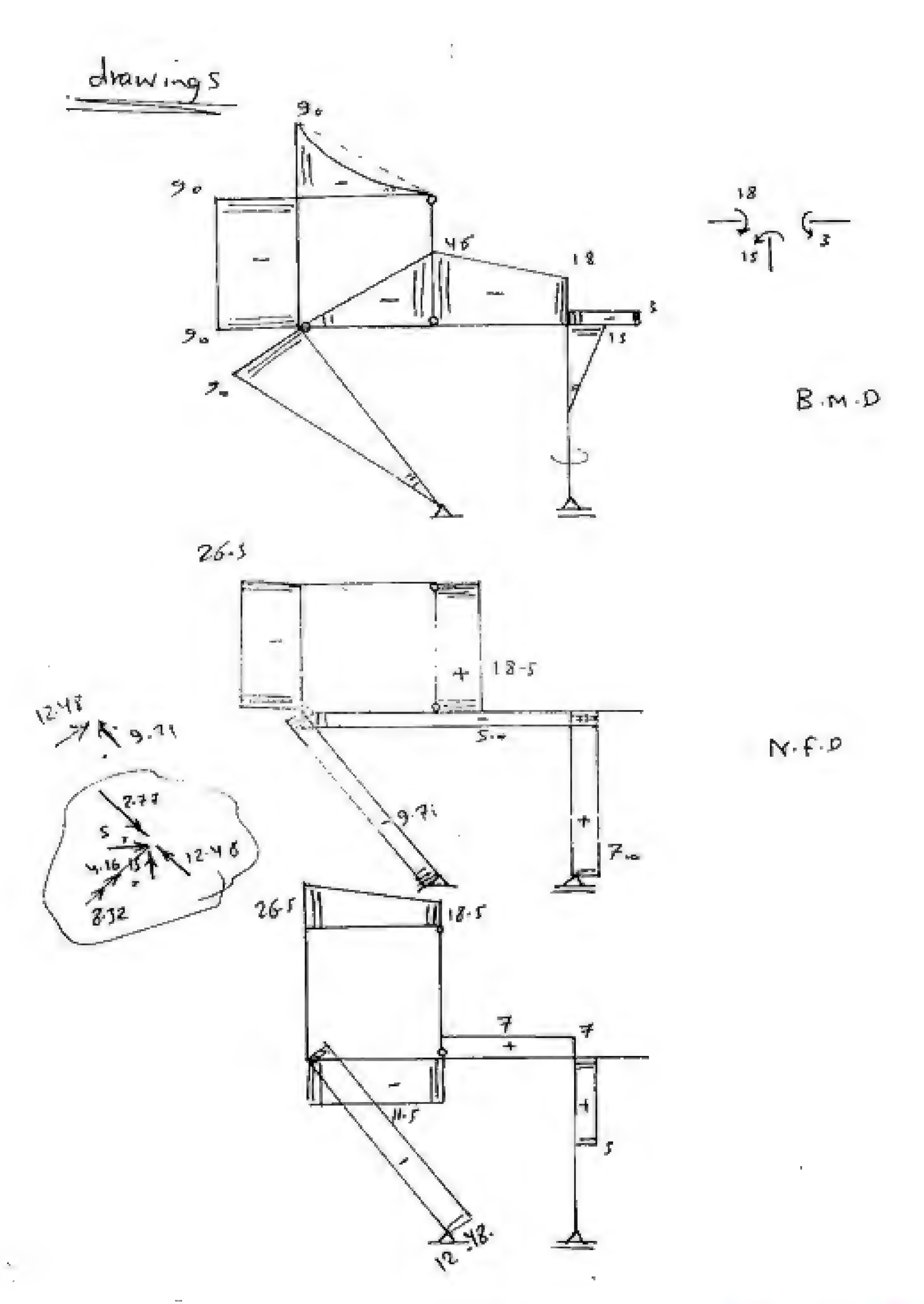
$$Y_A = 7 + 8 = 15 \text{ ton}$$

$* \ \Sigma M_{C_R} = 0.0$

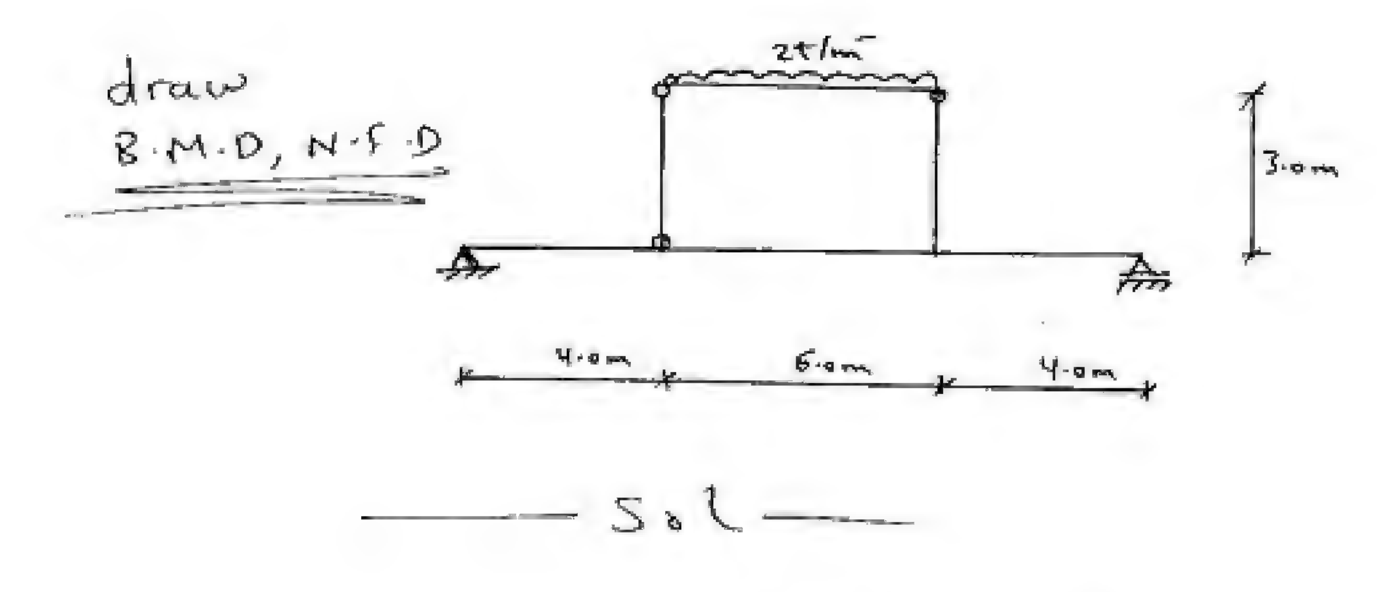
$$-5 * 3 + F * 4 - 3 - 7 * 8 = 0.0$$

$$\Rightarrow F = 18.5 \text{ ton}$$

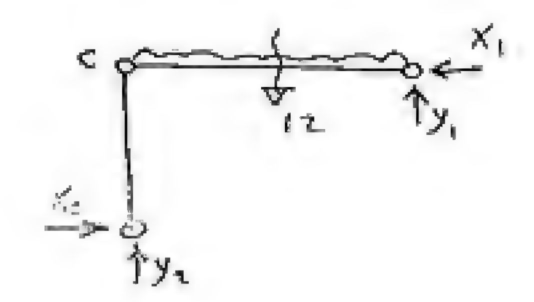



drawings
90
90
90
90
45
18
18
15
3
15
B.M.D
26.5
18.5
12.48
9.71
5.0
9.71
7.0
N.F.D
2.77
5
12.48
4.16
15
8.32
26.5
18.5
7
7
11.5
5
12.48

draw
B.M.D, N.F.D



— Sol —



$\sum M_{c_d} = 0.0$

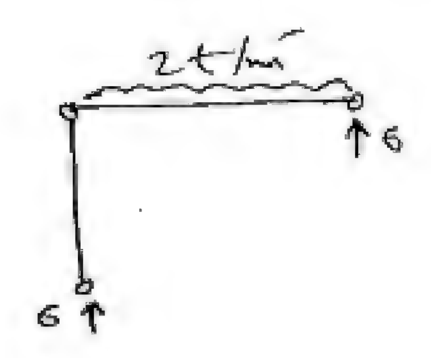
$X_2 = 0.0$

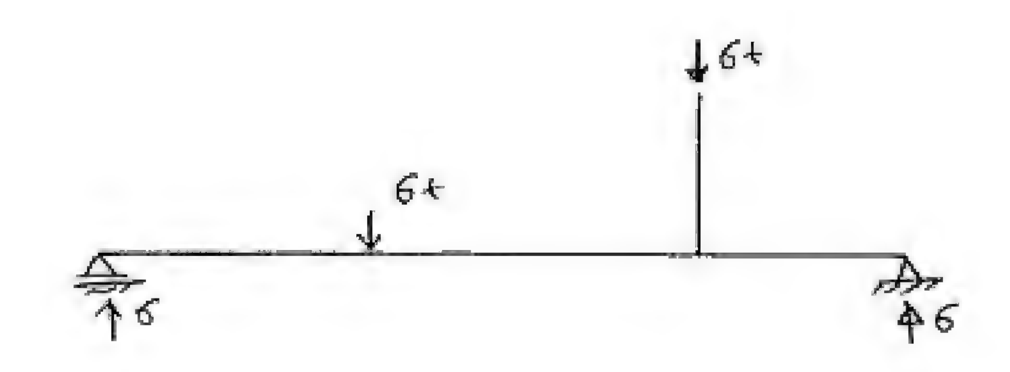
$\sum X = 0.0$

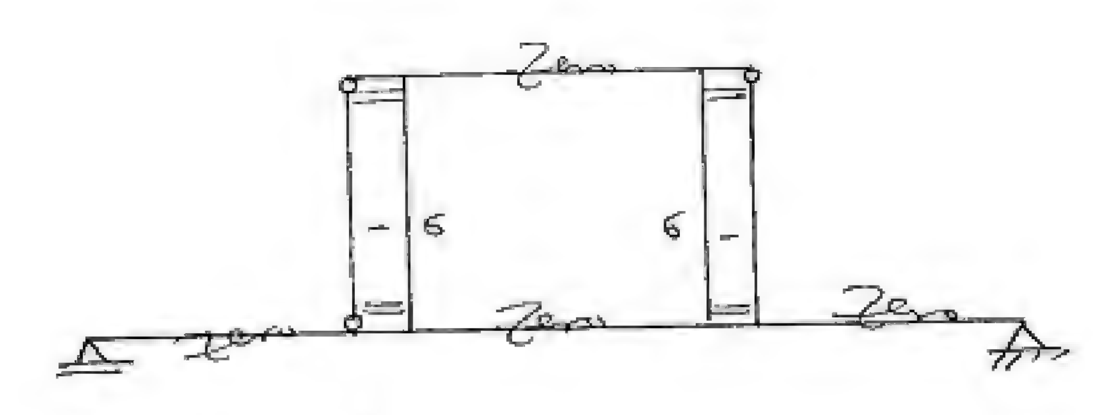
$X_1 = 0.0$

$\sum M_2 = 0.0$

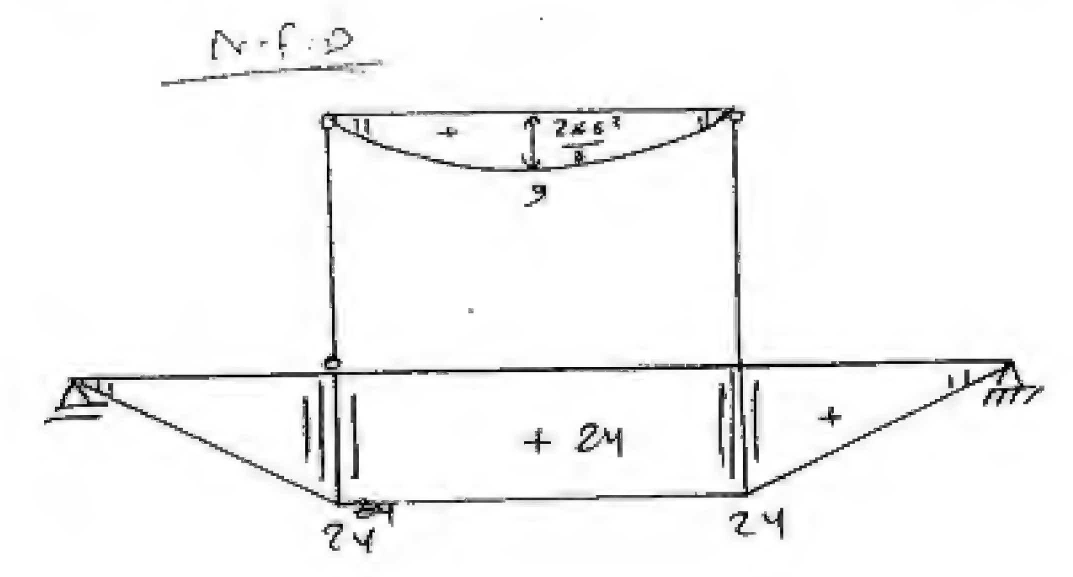
$\Rightarrow Y_1 = \frac{12}{2} = 6.0 \text{ t}_{on} = Y_2$



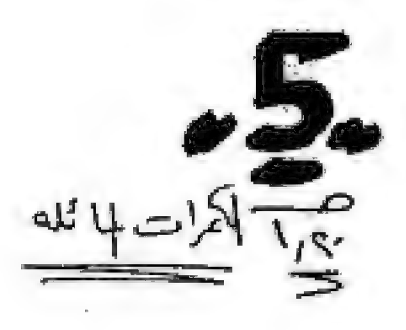




N.F.D

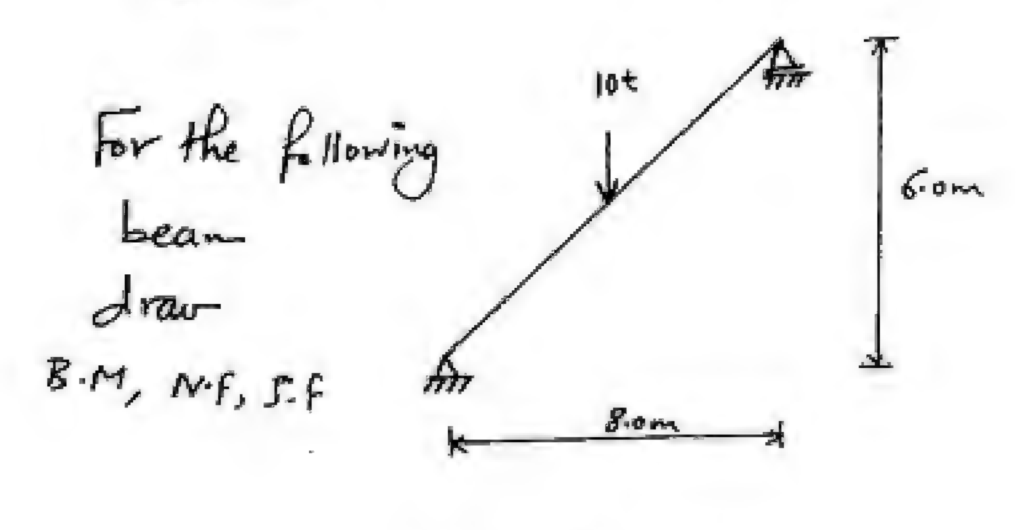


B.M.D



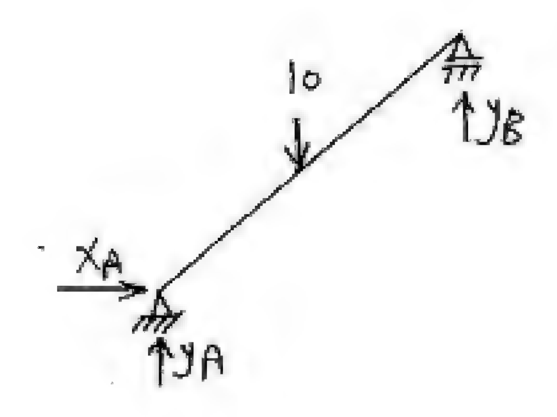
Example

For the following beam draw B.M, N.F, S.F



— Sol —

For Reactions



* $\Sigma X = 0.0$

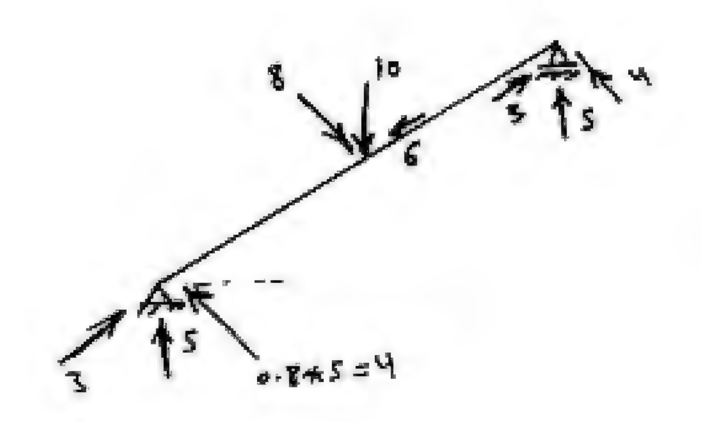
$X_A = 0.0$

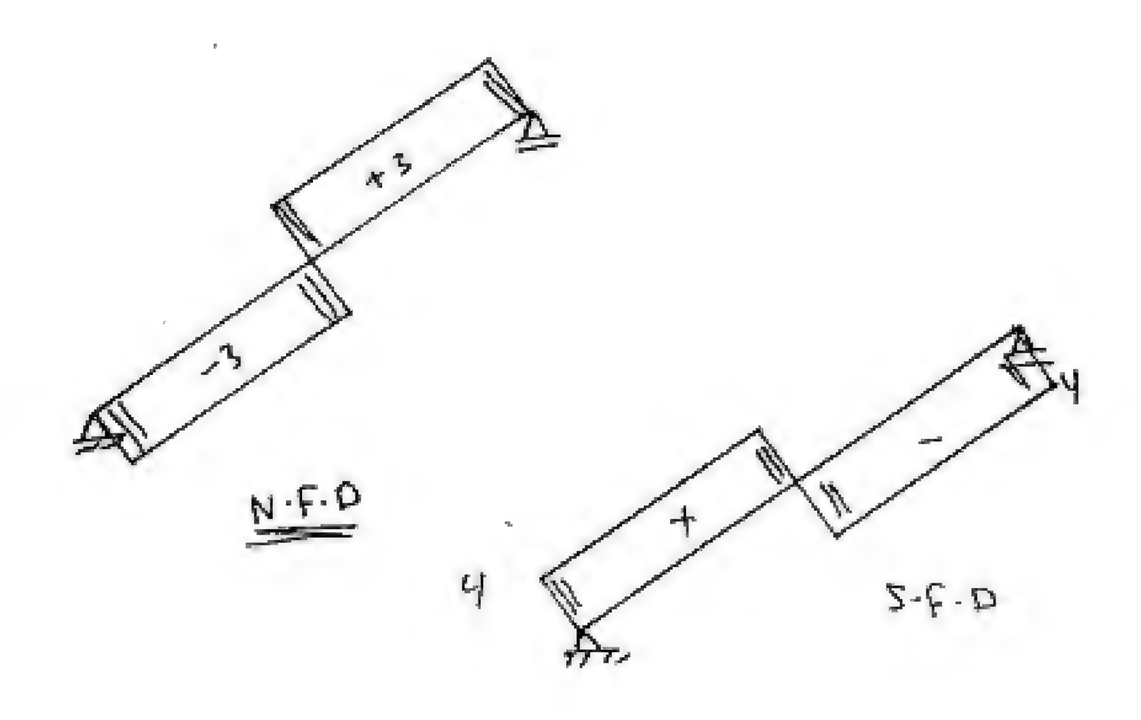
* $\Sigma M_A = 0.0$

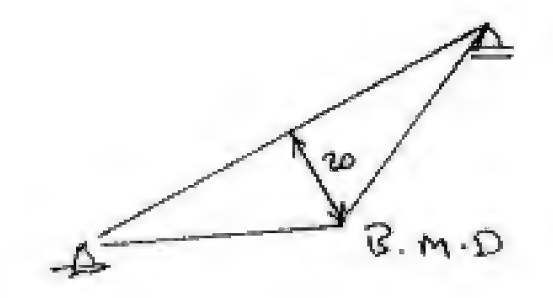
$10 * 4 - Y_B * 8 = 0.0$

$\Rightarrow Y_B = 10/2 = 5.0\,t$

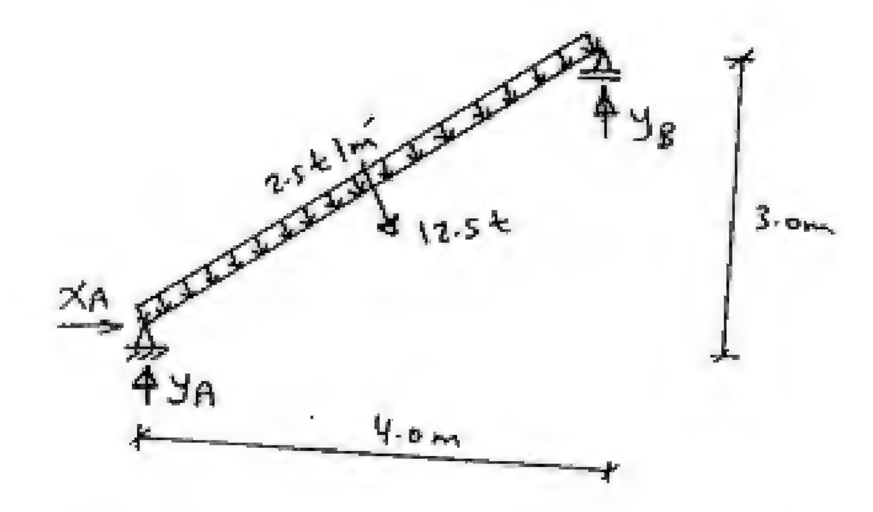
$\therefore \Sigma y = 0.0 \quad \Rightarrow Y_A = 5.0\,t$


8
10
6
3
5
4
3
5
0.8*5=4


+3
-3
N.F.D
4
+
-
4
S.F.D


20
B.M.D

Example ②



— Sol —

7.5
12.5
10

Reactions

$\rightarrow \Sigma X = 0.0$

$\Rightarrow X_A = -7.5$ ton.

$\curvearrowright \Sigma M_A = 0.0$

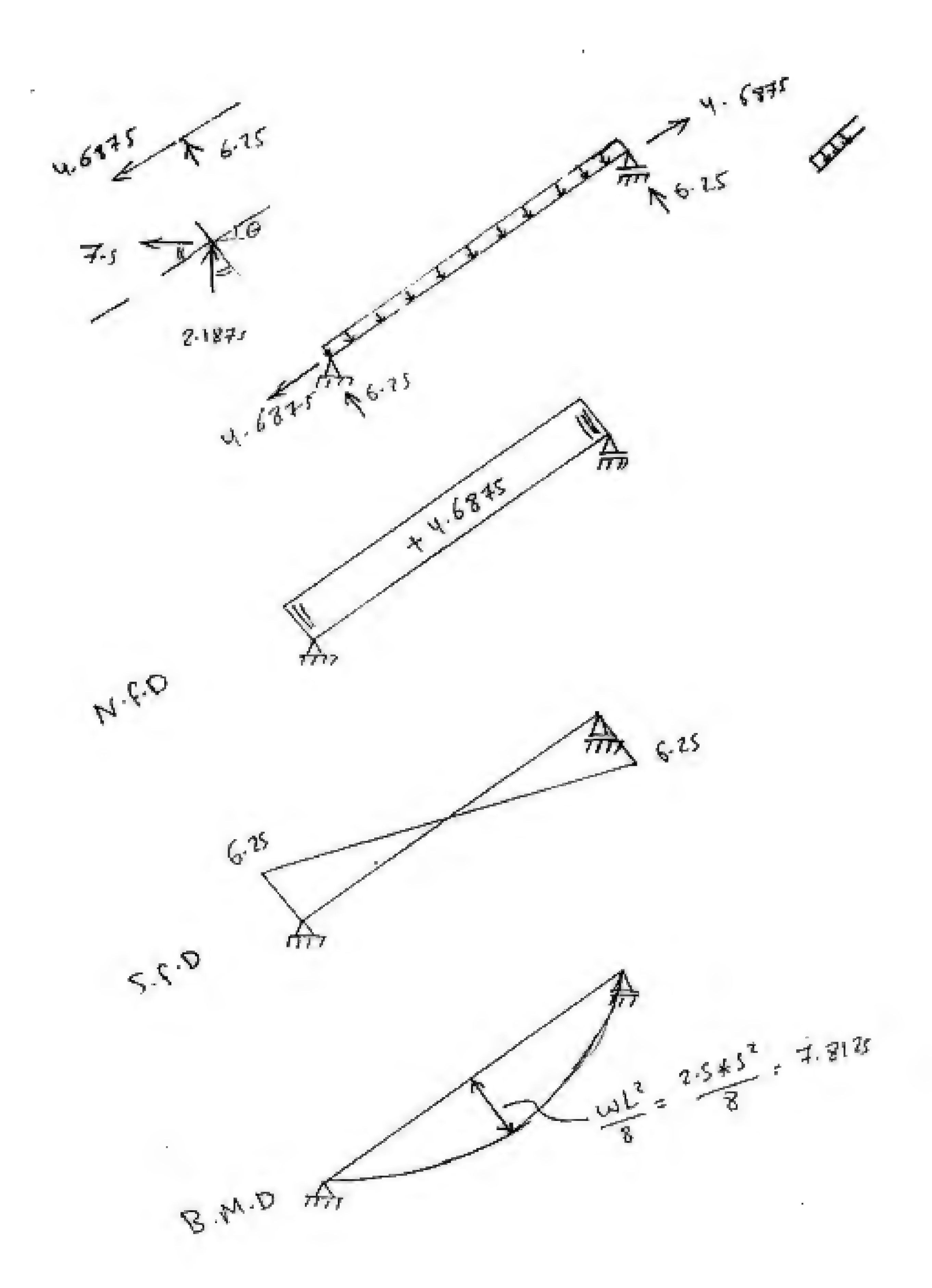
$\Rightarrow 12.5 * 2.5 - Y_B * 4 = 0.0$

$\Rightarrow Y_B = 7.8125$ ton.

$\uparrow \Sigma Y = 0.0$

$\Rightarrow Y_A = 10 - 7.8125$

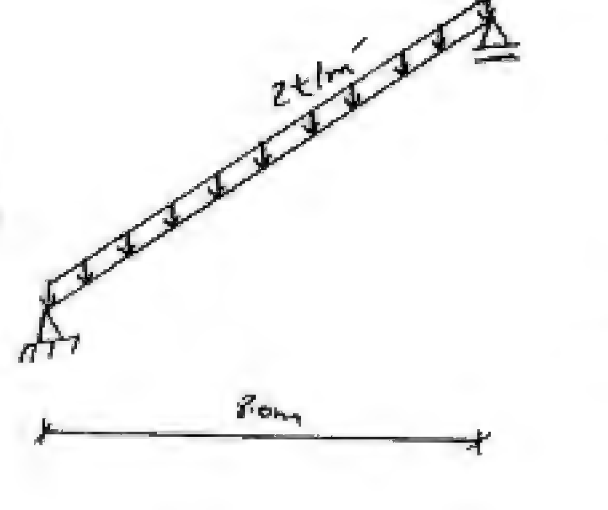
$= 2.1875$ ton.


4.6875
6.25
7.5
2.1875
4.6875
6.25
4.6875
6.25
+4.6875
N.F.D
6.25
6.25
S.F.D
$\frac{WL^2}{8} = \frac{2.5*5^2}{8} = 7.8125$
B.M.D

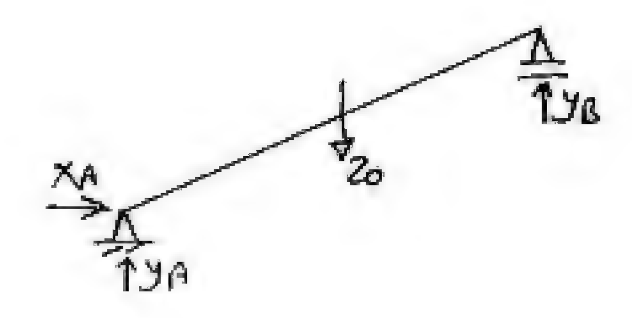


draw B.M.D

N.F.D, S.F.D



— SoL —



$\Sigma X = 0.0$

$\Rightarrow X_A = 0.0$

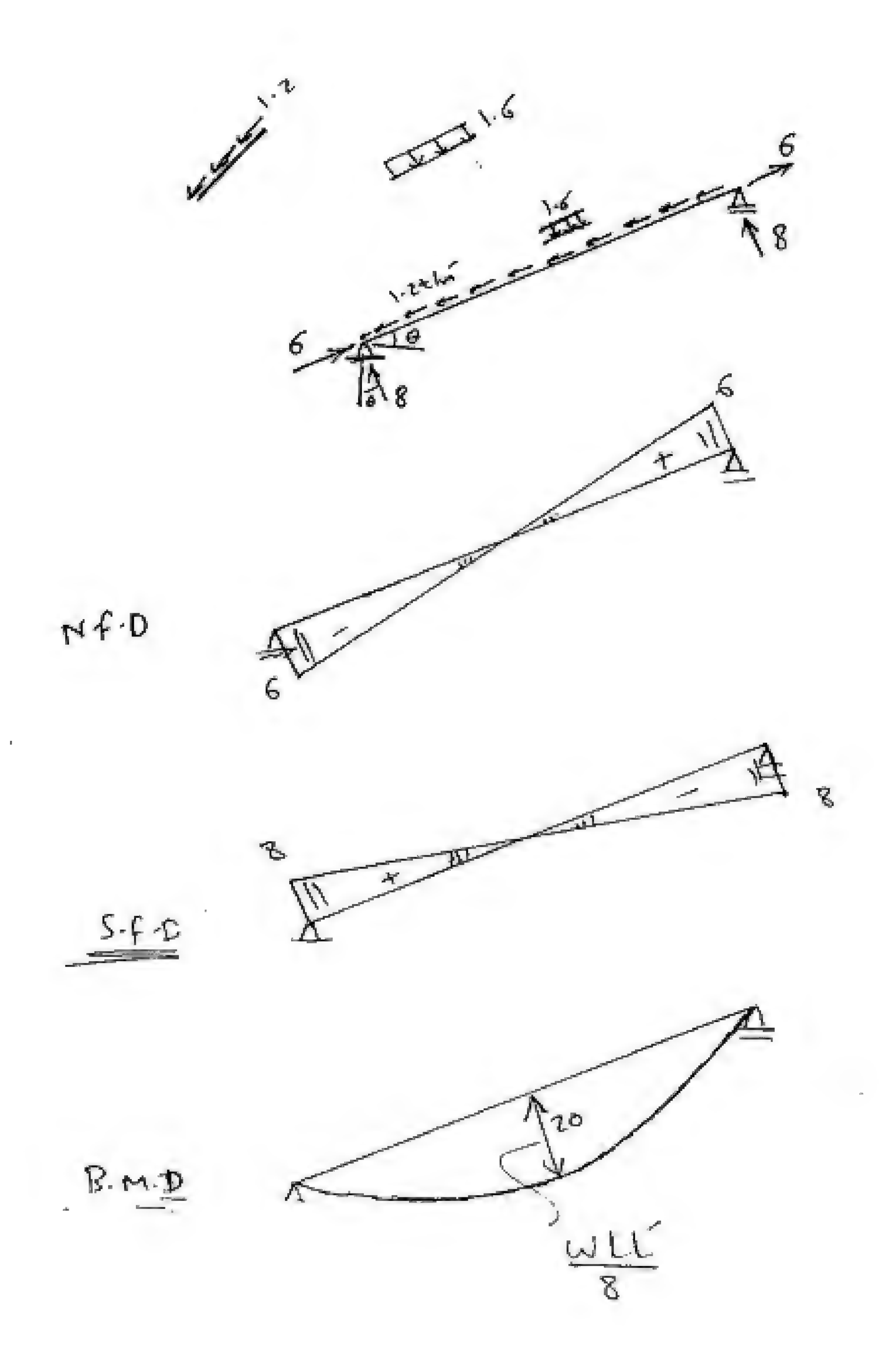
$\Sigma M_A = 0.0$

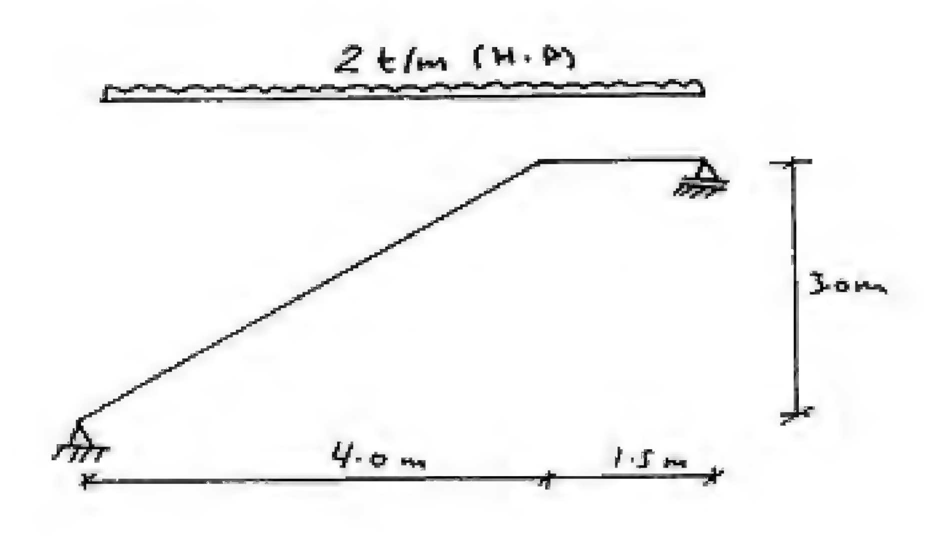
$\Rightarrow 20 * 4 - Y_B * 8 = 0.0$

$\Rightarrow Y_B = 10$ ton.

$\Sigma Y = 0.0$

$\Rightarrow Y_A = 10$ ton.


1.2
1.6
6
1.6
8
1.2+1.6
θ
6
8
6
+
-
6
N.F.D
8
-
8
+
S.F.D
20
B.M.D
WLL'
8



draw N.F.D , B.M.D and S.F.D

——— sol ———

[I] Reactions

5.5*2 = 11t on

X_A

Y_A

Y_B

* $\Sigma X = 0.0$

$\Rightarrow X_A = 0.0$

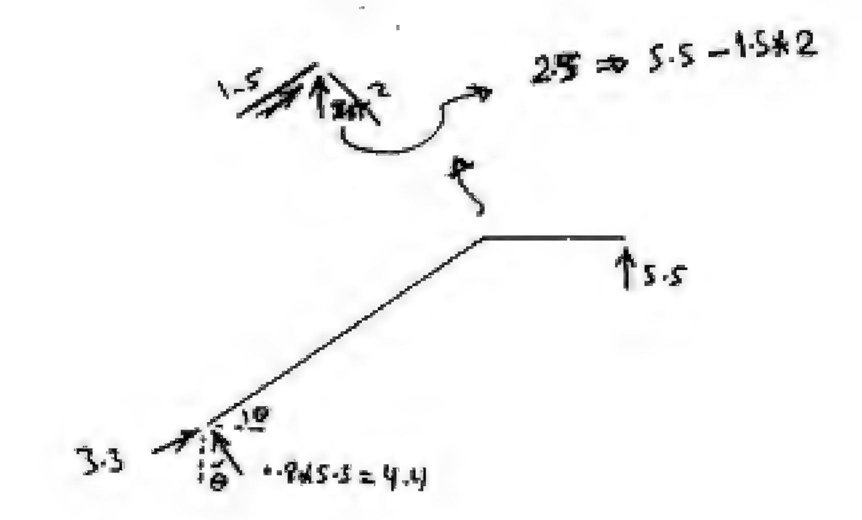
* $\Sigma M_A = 0.0$

$11 * 2.75 = Y_B * 5.5$

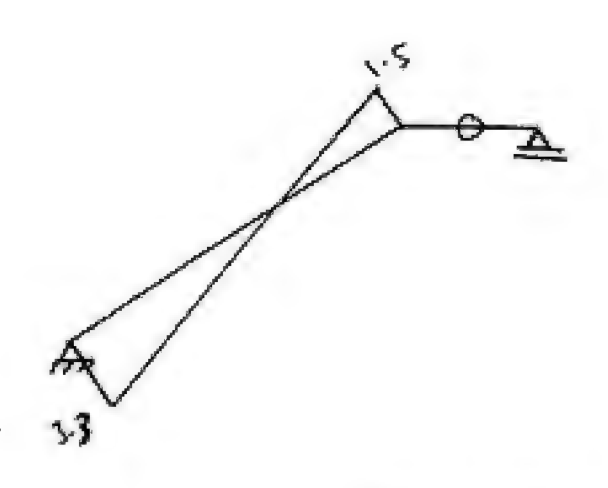
$\Rightarrow Y_B = 5.5$

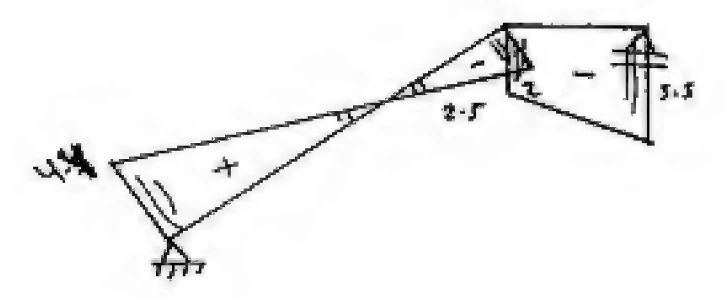
* $\Sigma Y = 0.0$

$Y_A = 5.5$

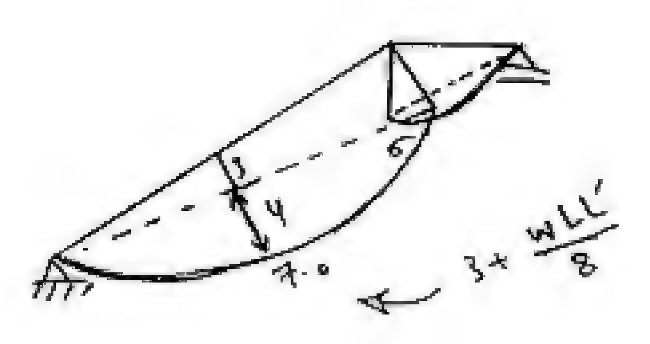


N.F.D

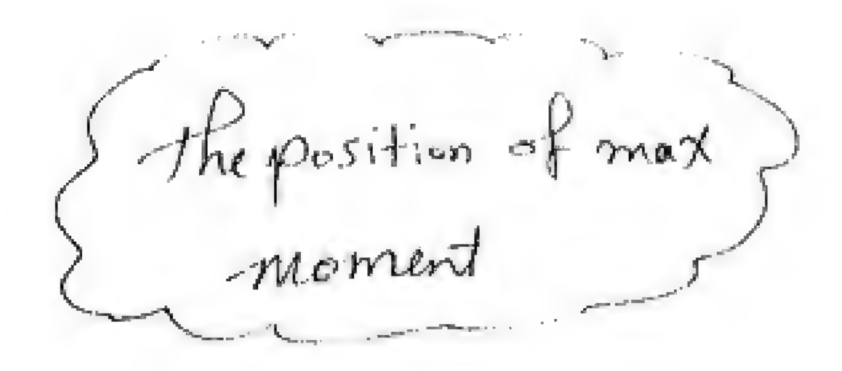


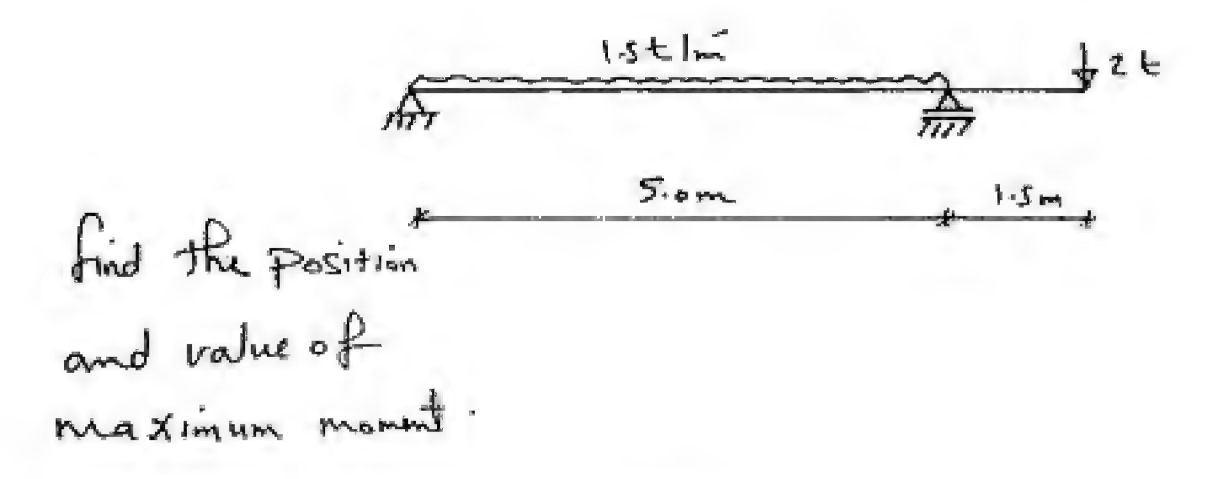


لاحظ



لازم الرسم يبقى هو هو
على كل حسب الجزئية

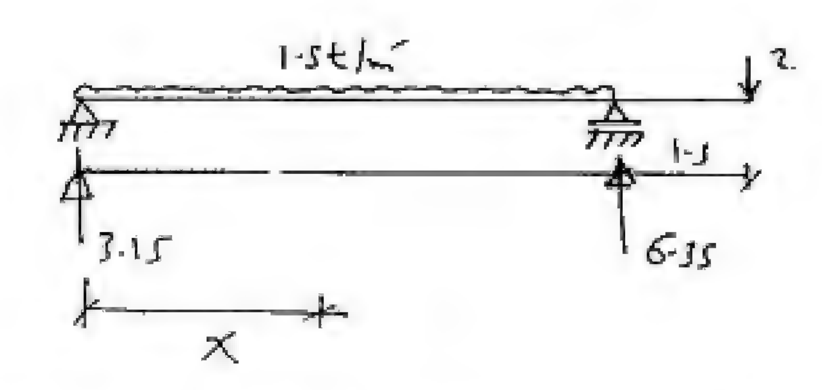




find the position and value of maximum moment.

— Sol —

يجي عند max moment اذا كان له Zero shear.



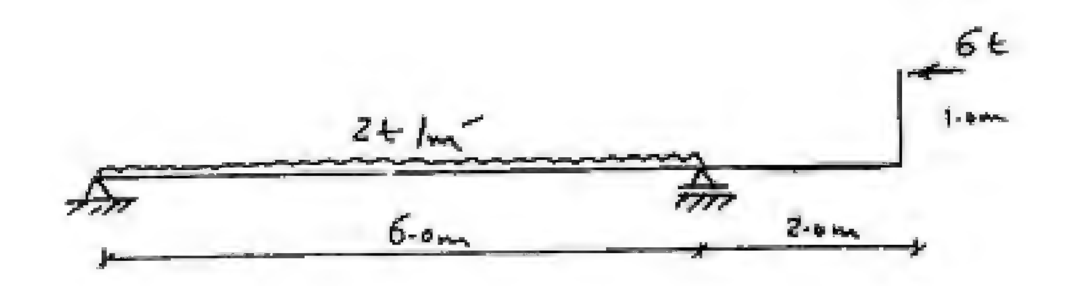
$$Q = 0.0 \Rightarrow 3.15 - 1.5X = 0.0 \Rightarrow X = 2.1\,m$$

$\Rightarrow M = 3.15 * 2.1 - 1.5 * 2.1 * \frac{2.1}{2}$

$= 3.3 \ t.m$

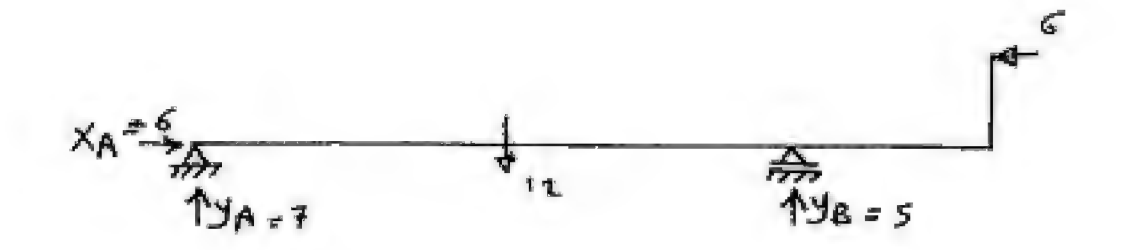
3.15

2.1



find the position and value of max B.M





Reactions

$\Rightarrow X_A = 6$ ton

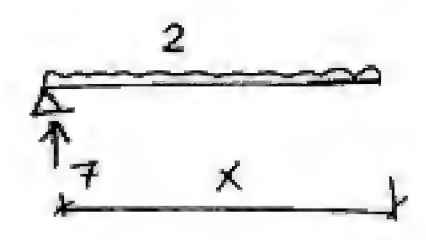
$\Rightarrow \Sigma M_A = 0.0$

$$12 * 3 - 6 * 1 - Y_B * 6 = 0.0$$

$$\Rightarrow Y_B = 5 \text{ ton}$$

$\Sigma y = 0.0 \quad \Rightarrow Y_A = 7$ ton.

The position of zero shear.



$Q = 0.0 = 7 - 2X$

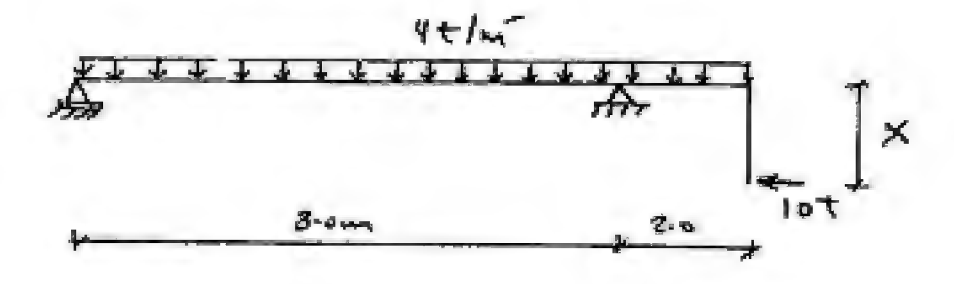
$\Rightarrow \boxed{X = 3.5\,m}$

$\therefore M = 7 \times 3 - 2 \times 3.5 \times \left(\frac{3.5}{2}\right)$

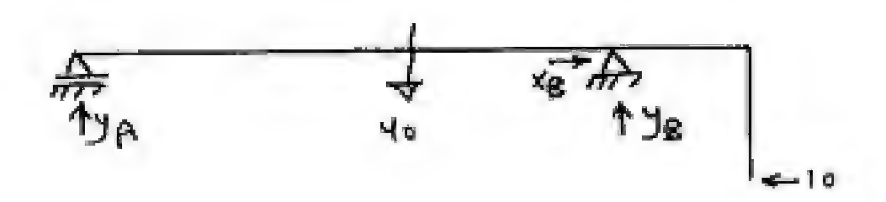
$= 8.75\ t.m$

Final 2001

Find the distance (X) so that the maximum (+ve) and (-ve) B.M are equal.



Find Reactions



$\Sigma X = 0.0 \Rightarrow X_B = 1.0$

$\Sigma M_A = 0.0 \Rightarrow 40 * 5 + 10X - y_B * 8 = 0.0$

$$\Rightarrow \boxed{y_B = 25 + 1.25X}$$

$\Sigma y = 0.0 \Rightarrow y_A = 40 - 25 - 1.25X$

$$\boxed{y_A = 15 - 1.25X}$$

Position of max +ve B.M.

$$Q_{s.o.o} = 15 - 1.25X - 4X'$$

$$\Rightarrow \boxed{X' = 3.75 - 0.3125\,X}$$

max M_{+ve}

$$= (15 - 1.25X) * [3.75 - 0.3125\,X] - 4\,[3.75 - 0.3125\,X]^2/2$$

$$= 56.25 - 4.6875X - 4.6875X + 0.39X^2 - 28.125 + 4.6875X - 0.1953X^2$$

$$= 0.194X^2 - 4.6875X + 28.125$$

max M_{-ve} =

$$M = 8*1 + 10X$$

$$= 8 + 10X$$

$$M_{+ve} = M_{-ve}$$

$$0.194X^2 - 4.6875X + 28.125 = 8 + 10X$$

$$\Rightarrow 0.194X^2 - 14.6875X + 20.125 = 0.0$$

$$X = 1.4\ m$$

"6"

بسم الله الرحمن الرحيم

determancy

there are 3 type of structures:-

(i) Stable :- منشأ متزن

{ *determinate :- عدد المعادلات = عدد المجاهيل

*indeterminate :- عدد المعادلات أقل من عدد المجاهيل }

(ii) unstable :- منشأ غير متزن.

(1) عدد المعادلات أكبر من عدد المجاهيل

(2) عدد المعادلات أقل من عدد المجاهيل ولكن يوجد جزء unstable في المنشأ.

جزء غير مستقر.

1- beams الكمرات

* حالات تجعل المنشأ unstable بمجرد النظر :-

1-

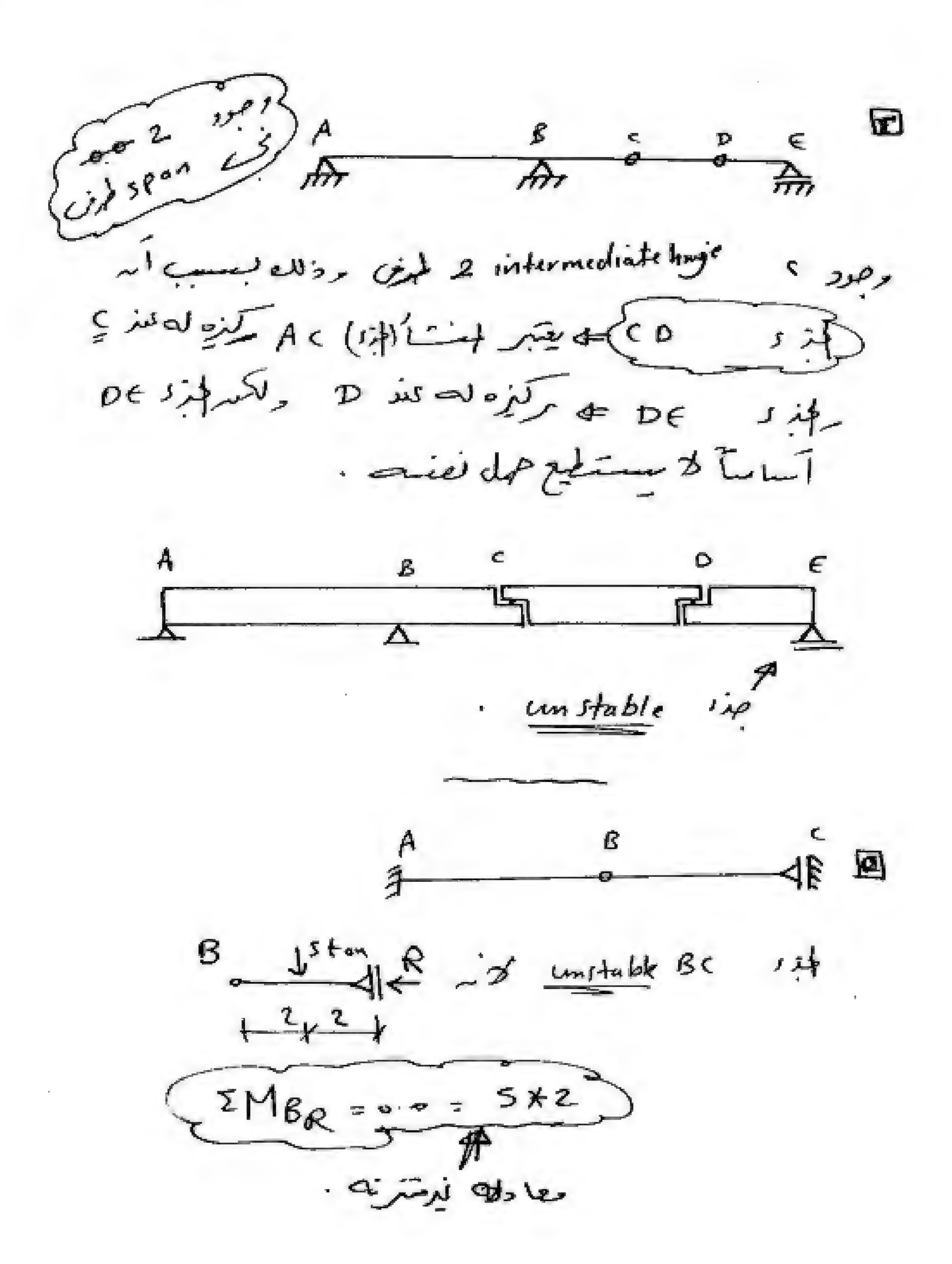
* هذا الشكل يسمى * 3 hinged beam
وهو غير مستقر لأن كل المعادلات
لا تستطيع الحصول على Reactions

2-

* هذا المنشأ الثلاث Reactions متوازية فهو غير مستقر أفقياً
حيث أنه قوة لا تستطيع
تجد رد فعل مضاد

3-

* الثلاث ردود الأفعال تتلاقى في نقطة بالتالي لو كان هناك
أي قوة وأخذ العزم حول (o)
لذلك لا يوجد Reaction
معاكس لهذا العزم .



وجود 2 hinge في span واحد
A B C D E
وجود 2 intermediate hinge في جزء وذلك بسبب أنه
الجزء CD يعتبر أنشأ (جزء) AC ركيزه له عند C
والجزء DE ركيزه له عند D ولكن الجزء DE
أساساً لا يستطيع حمل نفسه .
A B C D E
جزء unstable .
A B C
الجزء BC unstable لأن
B
5 ton
R
2 2
ΣM_BR = 0.0 = 5*2
معادلة غير متزنة .

[1]

موجود مثلاً Intermidiate ← من span وسط .

لأنه جزء منزلق يجب أنه يحمل الأجزاء وهو نفسه غير مستقر .

unstable

نفس المثال السابق ——o—o—o—— نفس الوضع .

[2] حالة عامة أن يكون عدد المجاهيل أقل من عدد المعادلات

* عدد المجاهيل = ٣

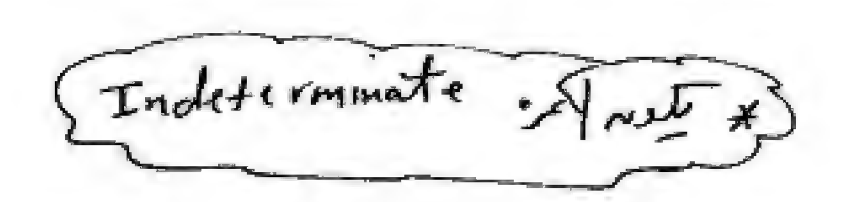
* عدد المعادلات = ٤

$3 \rightarrow \Sigma x = 0$

$\Sigma y = 0$

$\Sigma M_A = 0$

$1 \rightarrow$ intermidiate



إذا وجد عدد المجاهيل أكبر من عدد المعادلات
ولا يوجد بها أي حالة تجعلها unstable

لاحظ حالة وجود أي جزء مغلق يكون به ثلاث مجاهيل

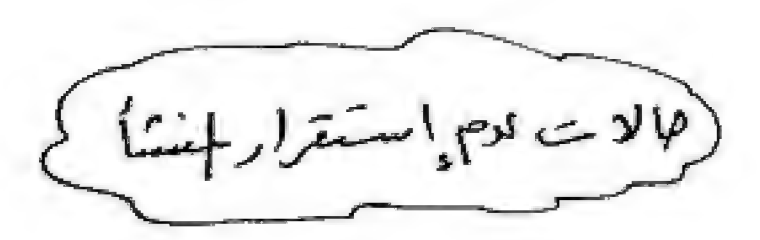
3 indeterminate ←

يتم وضع ثلاث intermediate للوصول
للوضع stable
determinate

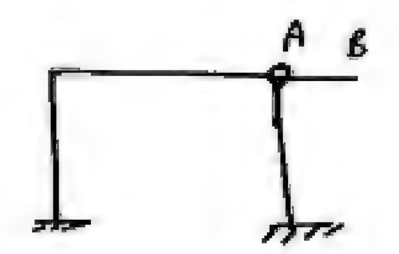
هذا الشكل يوجد به مجهولين
زيادة

2 indeterminate

2- Frames



1 وجود جزء unstable في المنشأ .



A o—— B هذا الجزء Cantilivor داخل في

بدايته في interm— وبالتالي افترض

$\Sigma M_{A_R} = 0.0$

ده لوجود حمل 5t على بعد 2

$\Sigma M_{A_R} = 0.0 = 5 * 2$

معادلة unstable

ده المنشأ بالكامل unstable

② وجود جزء من Frame بداية Intermediate زي كده

Roller عند نقطة Reaction في اتجاه عمودي

هذا الجزء غير مستقر

A
B
R

لاحظ هذا الجزء Stable

R

لاحظ الفرق مهم جدا جدا جدا

③ وجود الحالة العامة من عدد المعادلات أكبر من عدد المجاهيل

ok

(A)

حالة ماتكون الـ Indeterminate Frame

① حالة العادية عدد المعادلات < من عدد المجاهيل ولا يوجد به جزء unstable .

② وجود Close box

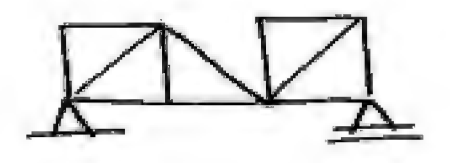
كل جزء مقفل به ثلاث مجاهيل.

3-truss

الحالات التي تجعل الـ truss ندترمنت

١- وجود مربع بدون عنصر diagonal

[٤] نقطه فصل اصلنا تعتبر (Intermediate)



يعتبر عدد المعادلة = 4.0
وعدد المجاهيل = 3.0

unstable

[٢]

هنا عدد المعادلات = عدد المجاهيل

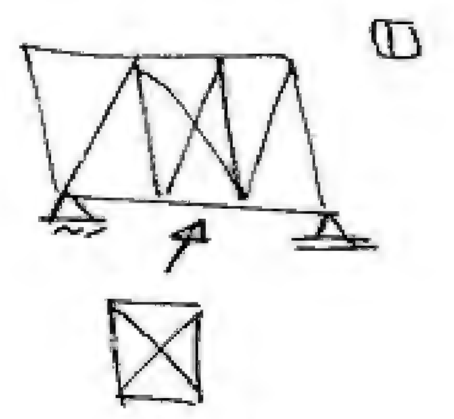
ولكن unstable لأنه مثل beam

حالة وجود indeterminate truss

[٥]

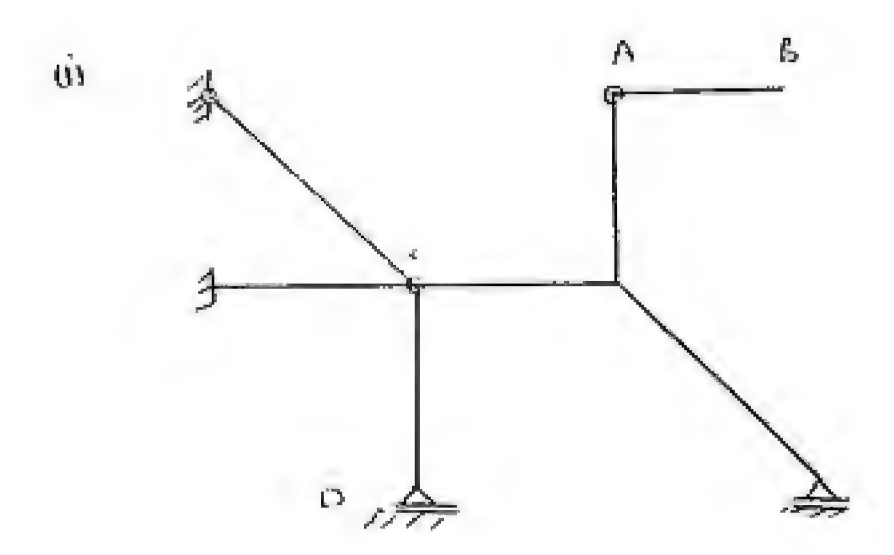
الحالة العاديه

[١]

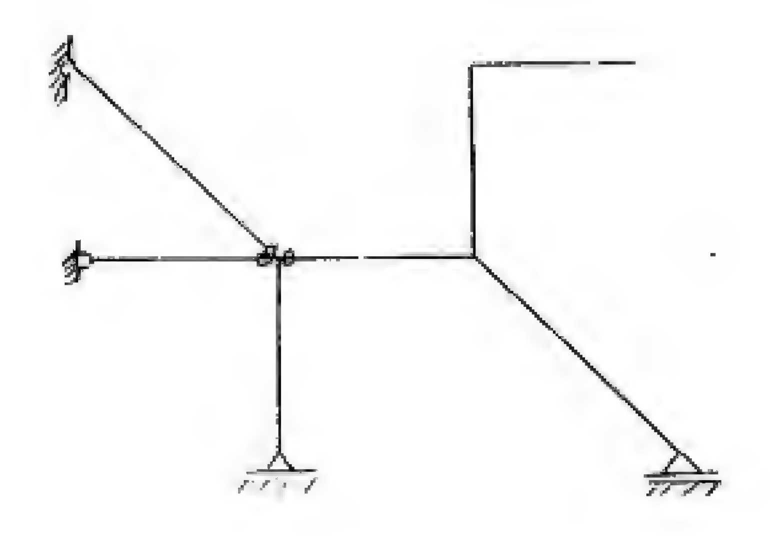


Final 2004

(i)

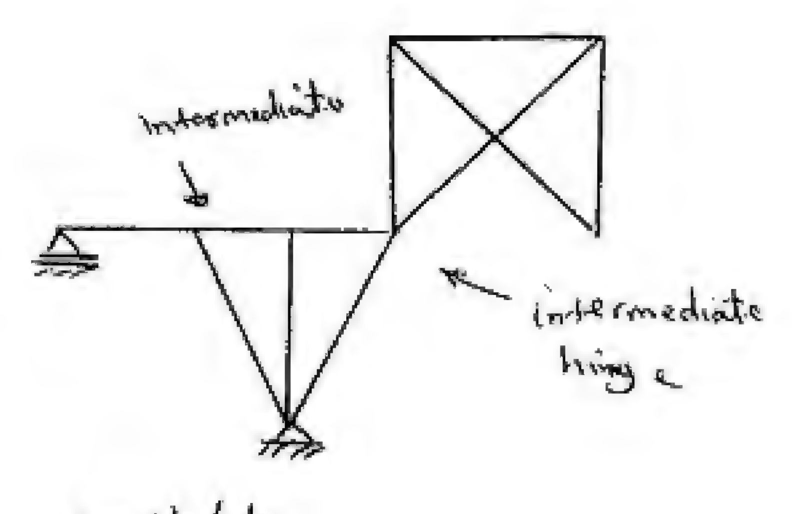


اعتبر AB ، CD غير مستقيمين



الحل

(ii)



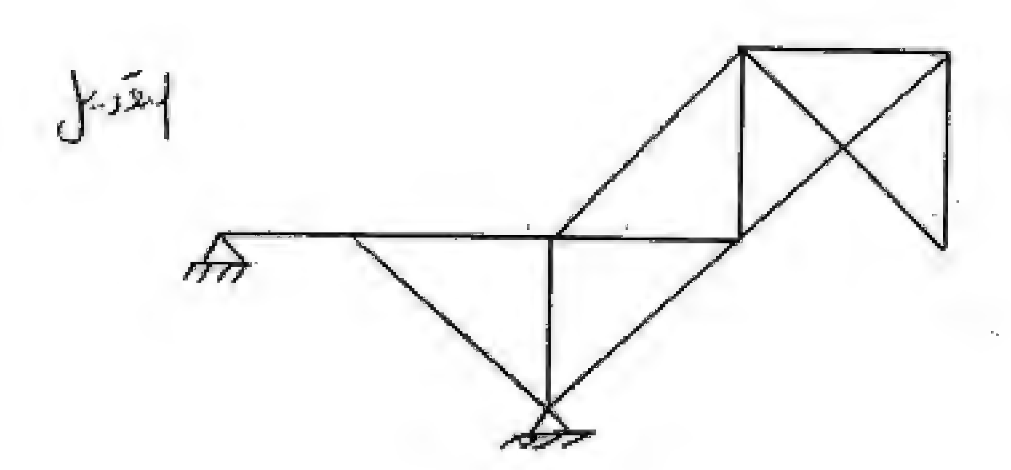
$2+3$ = عدد الرياكشنات

5 =

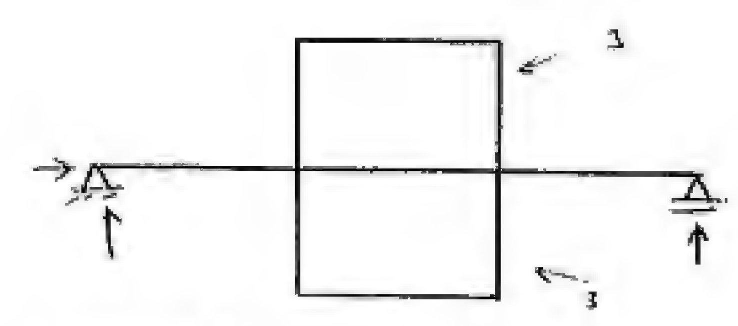
Unstable

3 = عدد المعادلات

تعديل





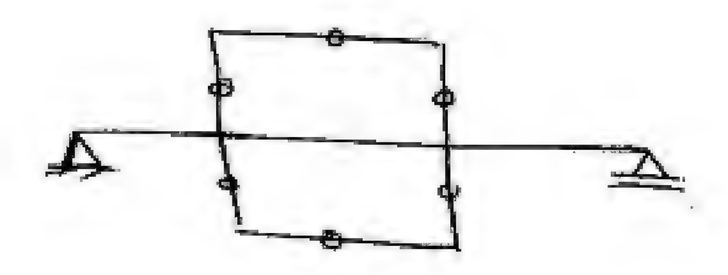


Stable & indeterminate

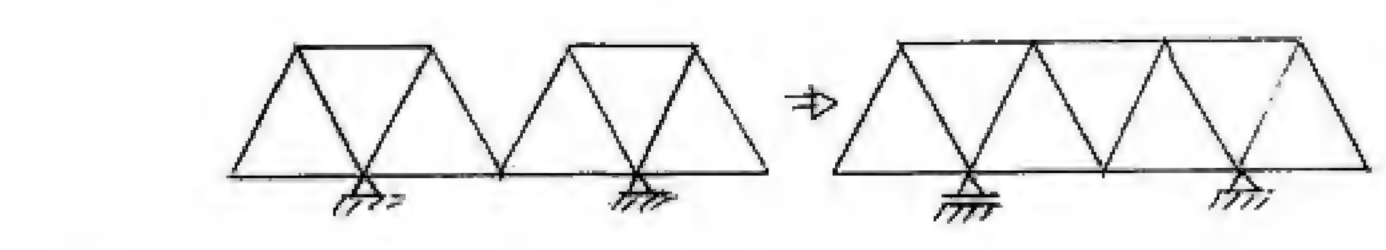
No of equations = 3

No of unknowns = 3+3+3 = 9

∴ 6 indeterminate

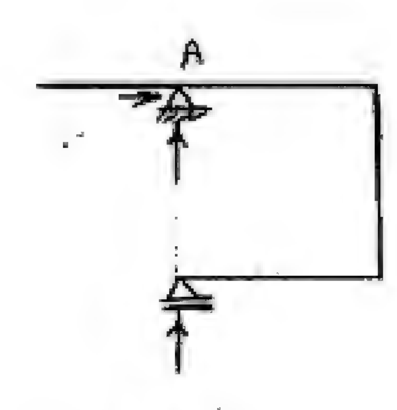


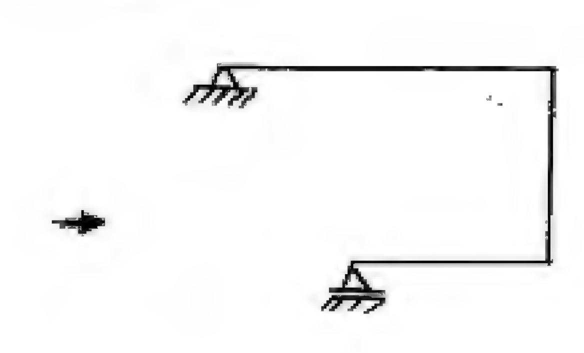




يعتبر 3 hinged على نفس المستوى
وبالتالي تصبح (unstable)
لأن عدد المعادلات
= عدد المجاهيل = 4.0

⇒ التعديل

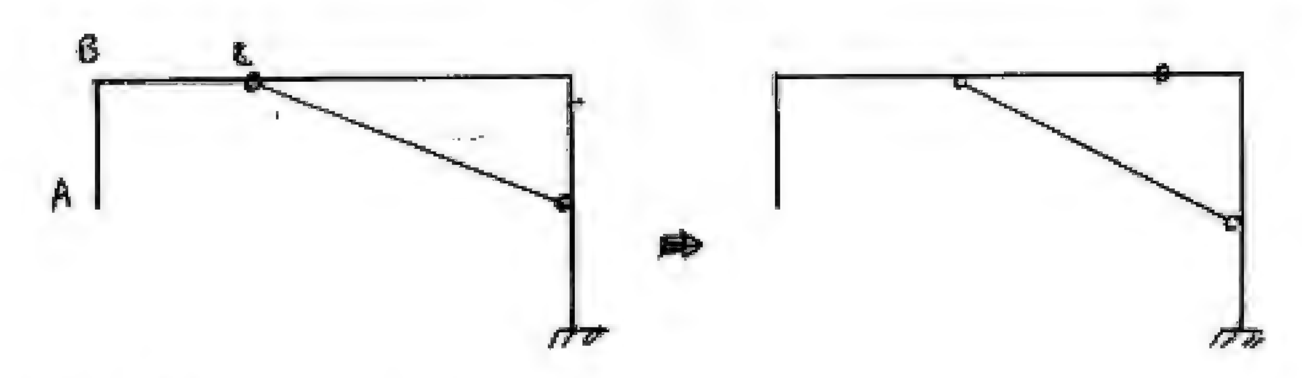




(unstable)
لأن الـ 3 ردود أفعال تتلاقى
في نقطة.

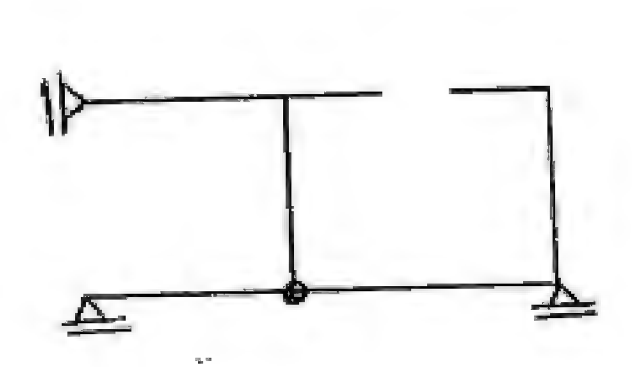
التعديل

لتكون
Stable & determinate



لأن ABC unstable

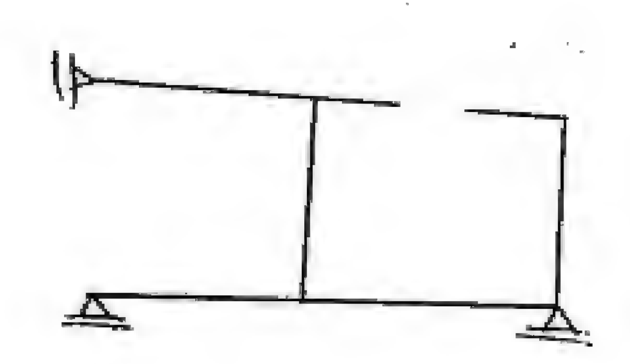
المنشأ كله unstable



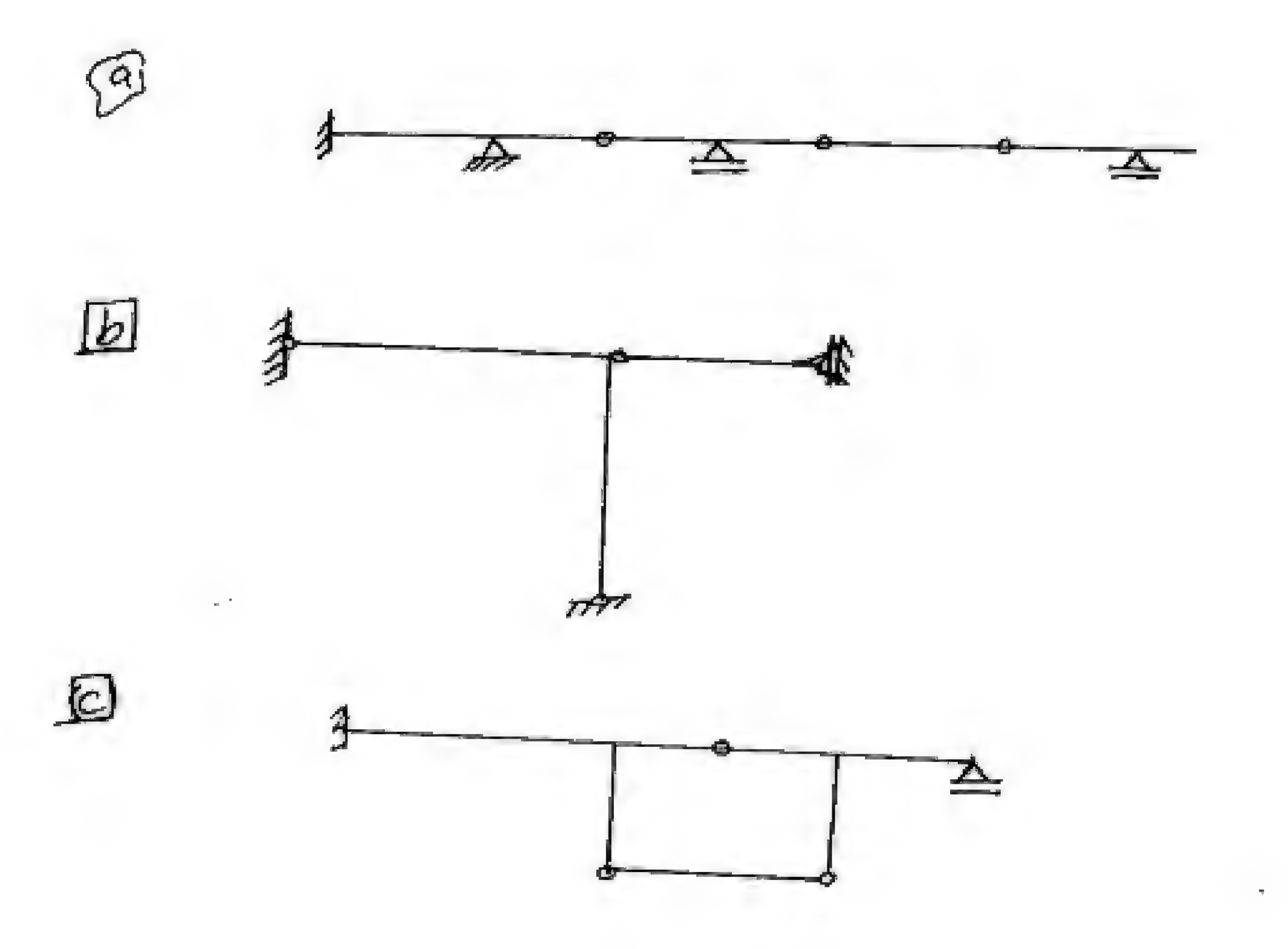
عدد المعادلات = 2+3 = 5

عدد المجاهيل = 3

unstable



* check the stability & determency for the given structure. and if not (stable & determinate) what do you want to do.



For (a)

unstable لأنه هناك 2-intern في span طرفي

التعديل

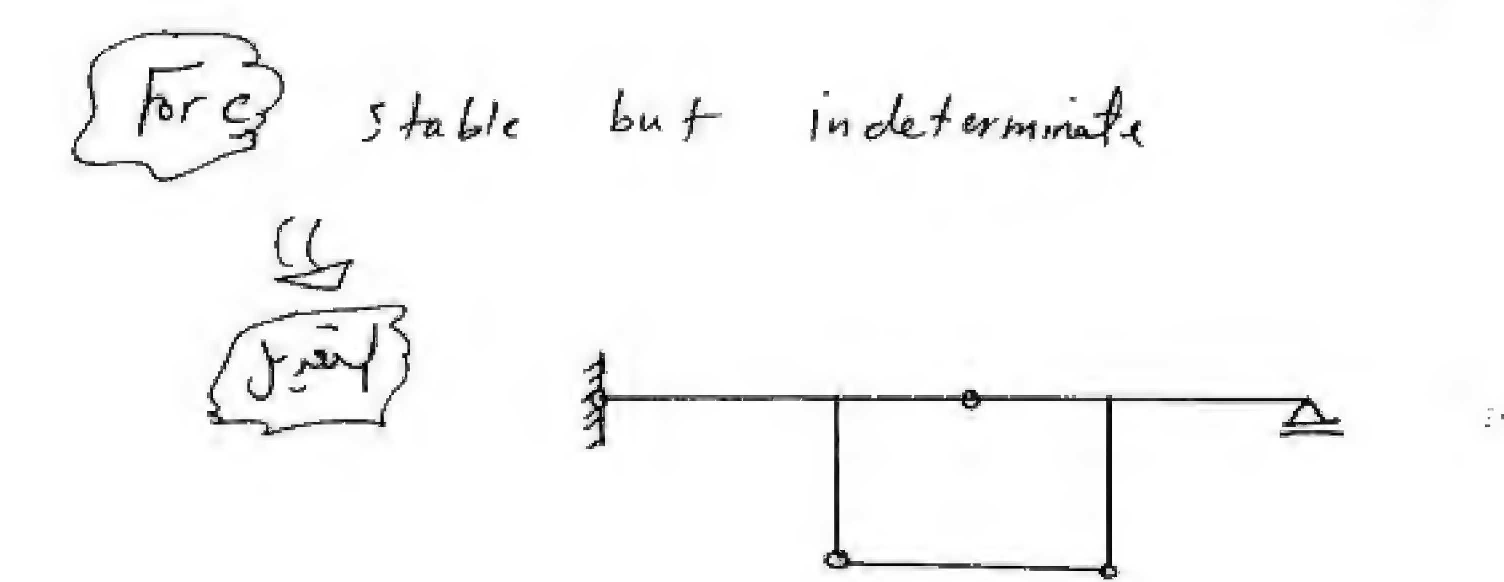
For (b) unstable

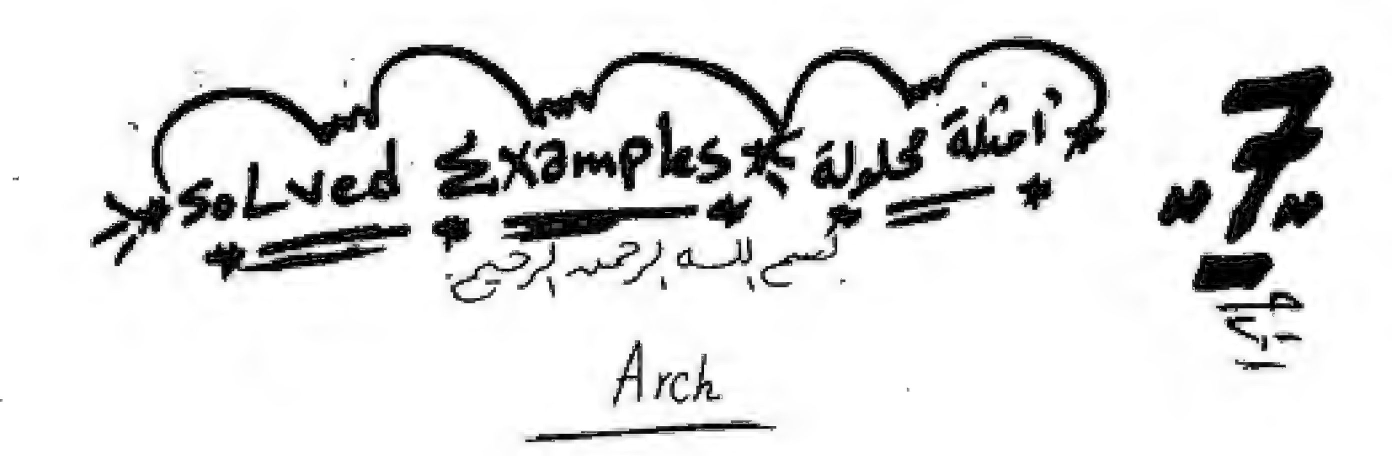
لأنه هناك

عند الاتصال بالعنصر لا يمكن أن Reaction يرد أي حمل عليه

لأنه Reaction الوحيد باتجاه العنصر

التعديل


For c
stable but indeterminate



Arch

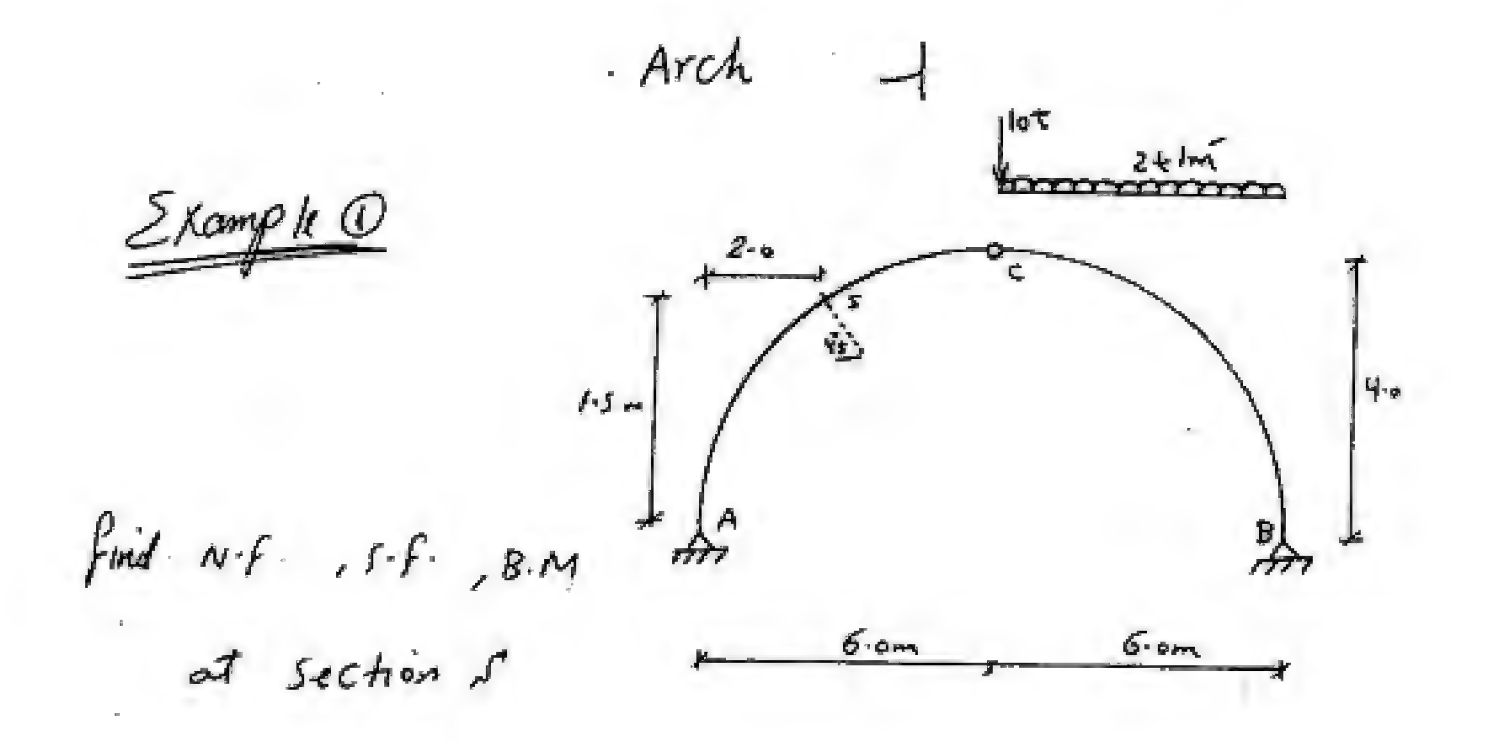
تنقسم مسائل الـ Arch في الإمتحان إلى نوعين :-

١- يعطي Arch ← يتم طلب B.M. , S.F. , N.F. عند نقطة معينة

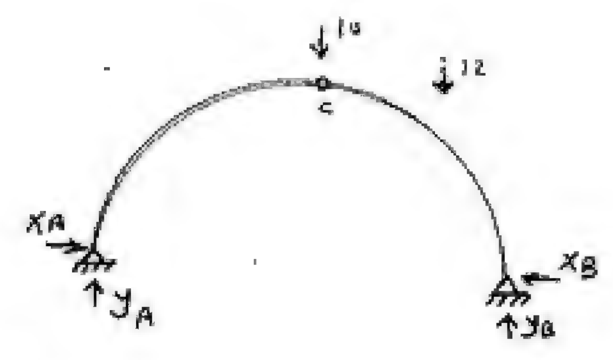
يعطي (الزاوية عندها) أو يتم حسابها.

٢- يعطي Arch ← يتم طلب B.M.D, S.F.D, N.F.D draw على كامل

الـ Arch .



(1) Reactions



$* \ \sum M_A = 0.0$

$10*6 + 12*9 - y_B * 12 = 0.0$

$y_B = 14.0$ ton.

$* \ \sum M_{c_R} = 0.0$

$12*3 - 14*6 + X_B * 4 = 0.0$

$X_B = 12.0$ ton.

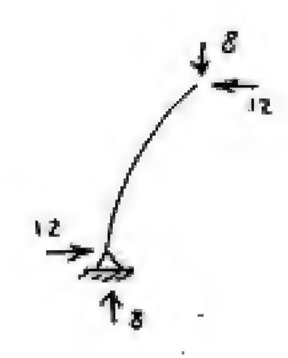
$* \ \sum y = 0.0$

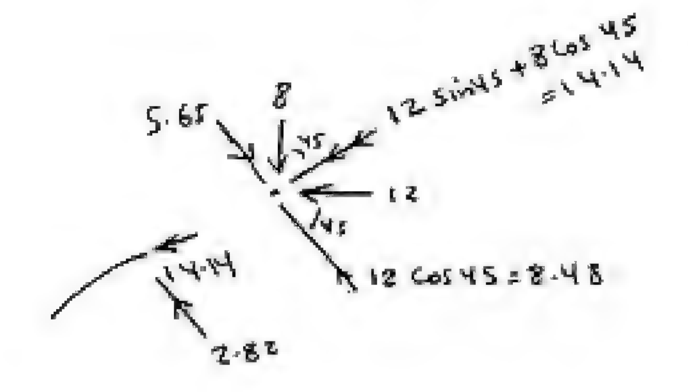
$y_A = 10 + 12 - 14 = 8$ ton.

$* \ \sum X = 0.0$

$X_A = 12.0$ ton.

(2) N.F, B.M, S.F





$N.F = -14.14$ ضغط

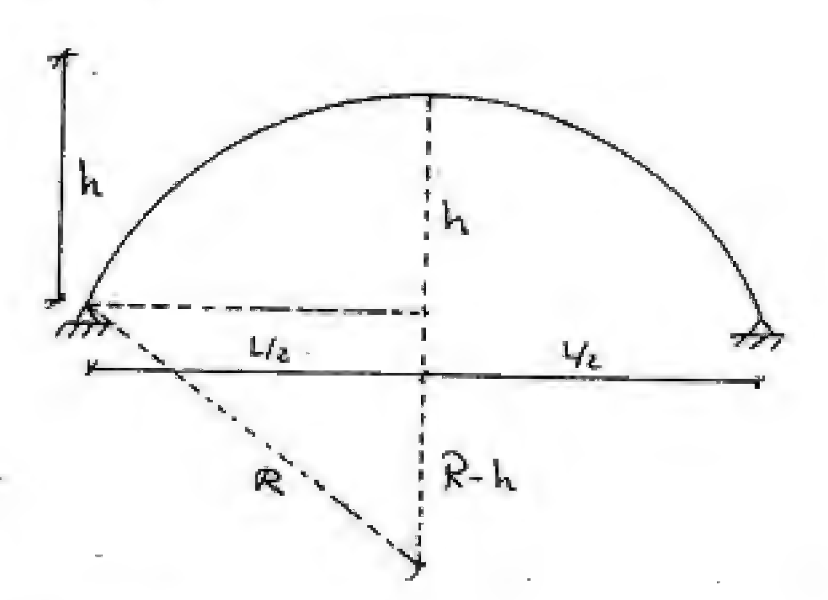
$S.F = -2.82$ عمير طالع .

$B.M = -12 * 1.5 + 8 * 2$

$= -2 \ t.m$

For Circular Arch

يتم حساب الزاويه عند اى قطاع .



(I) optain R "Radius"

$$R^2 = \left(\frac{L}{2}\right)^2 + (R-h)^2$$

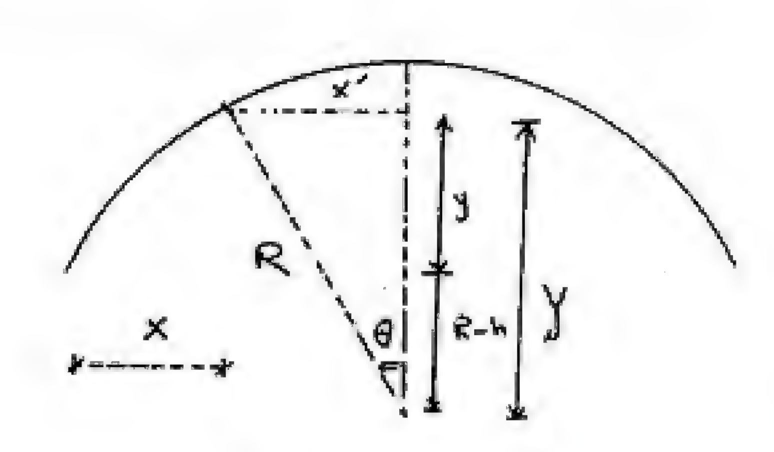
(II) given x for any point You Can Find θ

$$x' = \frac{L}{2} - x$$

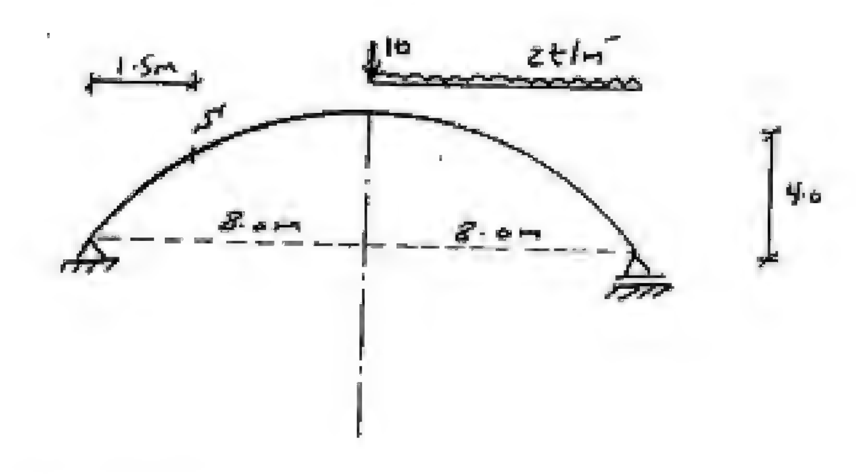
$$Y = \sqrt{R^2 - x'^2}$$

$$y = Y - (R-h)$$

$$\theta = \tan\left(\frac{x'}{Y}\right)$$



find N.F, S.F
B.M
at sections.



— Sol —

XA
8
R-4
R
θ
YA
YB

Get R

$$R^2 = 8^2 + (R-4)^2$$

$$R^2 = 64 + R^2 - 8R + 16$$

$$8R = 80$$

$$R = 10m.$$

$$\theta = \tan^{-1}\left(\frac{8}{6}\right) = 53.13^\circ$$

Find Reaction

- $\Sigma X = 0.0$

$\Rightarrow X_A = 0.0$

* $\sum M_A = 0.0$

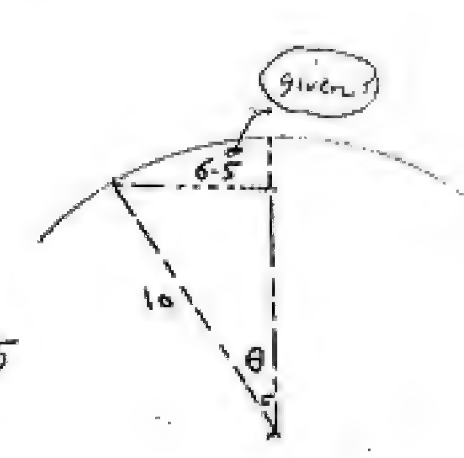
$$\Rightarrow 10 * 8 + 16 * 12 - y_B * 16 = 0.0$$

$$\Rightarrow y_B = 17 \text{ ton}.$$

* $\sum y = 0.0$

$$\Rightarrow y_A = 26 - 17 = 9 \text{ ton}.$$

Finding N.F, B.M, S.F



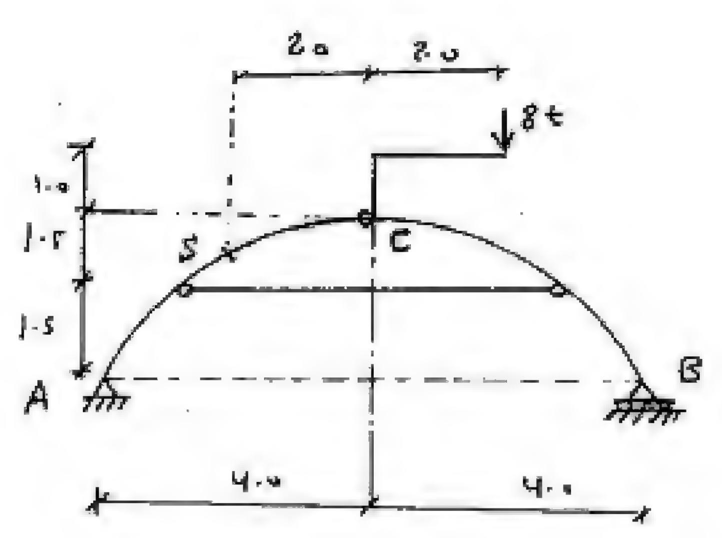
$\theta = \sin^{-1}\left(\frac{6.5}{10}\right) = 40.5$ $\Rightarrow \cos\theta = 0.76$
$\Rightarrow \sin\theta = 0.65$

$N = -5.85$ t

$S.F = +6.84$ t

$B.M = 9 * 1.5 = 13.5$ t.m

Final 2004



For the Following Arch calculate N.F, S.F and B.M at section "S"

— Sol —

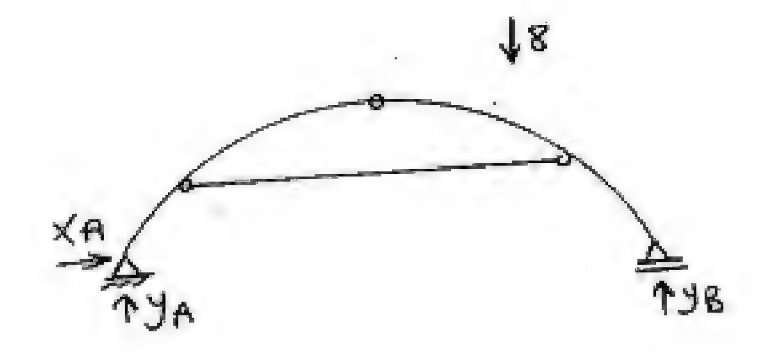
Finding Radius (R)

$$R^2 = (R-h)^2 + (L/2)^2$$

$$R^2 = (R-3)^2 + 4^2$$

$$R = 5.0\ m$$

For Reactions



* $\sum X = 0.0$

$\Rightarrow X_A = 0.0$

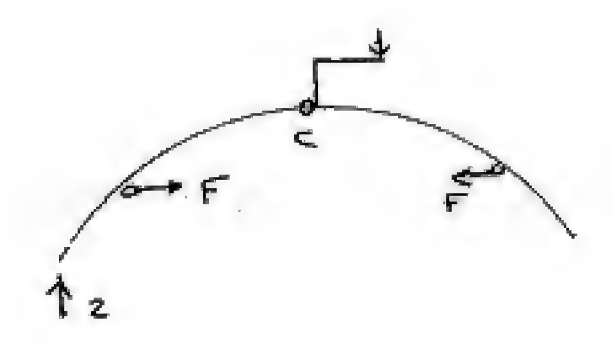
* $\sum M_A = 0.0$

$\Rightarrow 8 * 6.0 - Y_B * 8 = 0.0$

$Y_B = 6.0$ ton.

* $\sum Y = 0.0$

$\Rightarrow Y_A = 8 - 6 = 2.0$ ton.

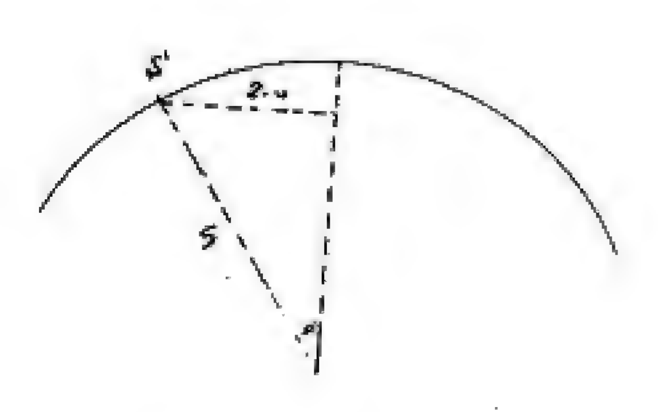


$\sum M_{C_L} = 0.0$

$F * 1.5 - 2 * 4 = 0.0$

$\Rightarrow F = 5.33$ ton.

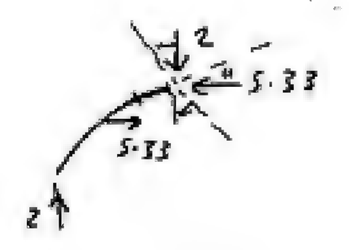
For θ at section (5')



$$\theta = \sin^{-1}\left(\frac{2}{5}\right) = 23.5$$

$$\cos\theta = 0.916$$

$$\sin\theta = 0.4$$



$$N = -[2\sin\theta + 5.33\cos\theta]$$
$$= 5.682 \text{ ton}$$

$$S.F = 2\cos\theta - 5.33\sin\theta$$
$$= -0.3$$

$$B.M = 2 * 2 - 5.33 * 1.5$$
$$= -4 \text{ t.m}$$

For the following Arched-frame draw N.F.D S.F.D and B.M.D

الحل الوحيد نعادله لمركز دائرة.

— Sol —

$\curvearrowleft \sum M_{c_R} = 0.0$

$\Rightarrow 2*2*1 - Y_B*2 = 0.0$

$\Rightarrow Y_B = 2 \text{ ton}.$

$\curvearrowleft \sum M_A = 0.0$

$\Rightarrow 4*5 - 2*6 - X_B*4 = 0.0$

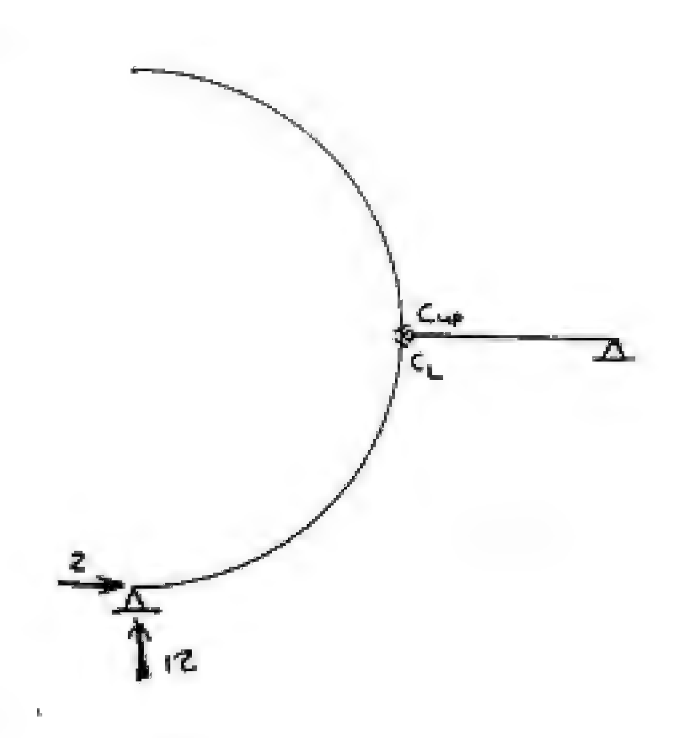
$\Rightarrow X_B = 2 \text{ ton}$

* $\Sigma X = 0.0$

$\Rightarrow X_A = 2.0$ ton.

* $\Sigma y = 0.0$

$\Rightarrow y_A = 12$ ton



$N_A = -2$

$N_{C_L} = -12$

$N_{Cup} = -10$

$N_d = 0.0$

$sh_A = +12$

$sh_{C_L} = -2$

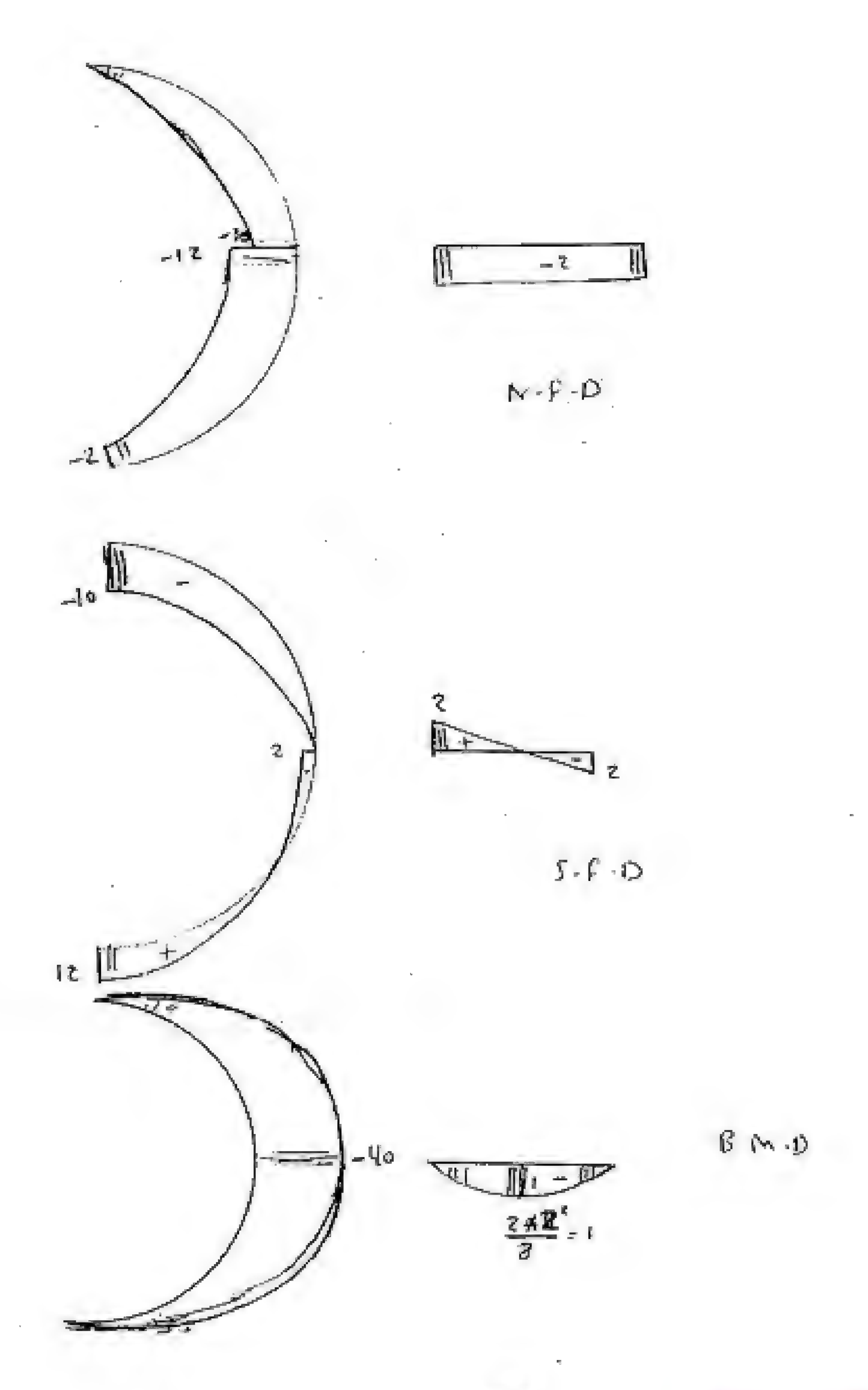
$sh_{up} = 0.0$

$sh_d = -10$

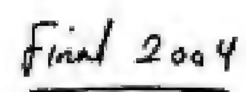
$M_A = 0.0$

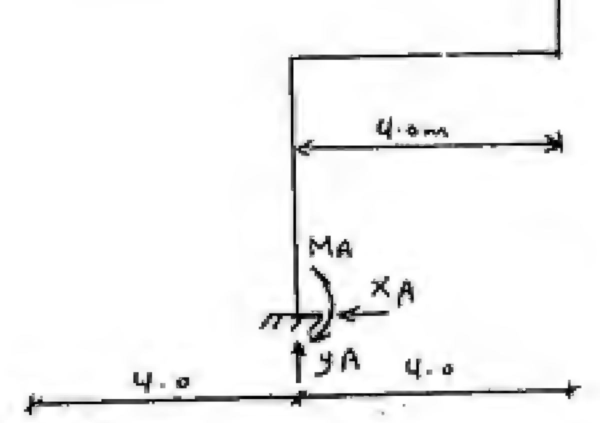
$M_{C_L} = M_{Cup} = -10 * 4 = -40$

$M_d = 0.0$



-12
-2
-2
N.F.D
-10
2
2
2
12
S.F.D
-40
B.M.D





draw B.M.D

N.F.D and N.F.D

— Sol —

* $\Sigma X = 0.0$

$X_A = 0.0$

* $\Sigma Y = 0.0$

$Y_A = 15t$

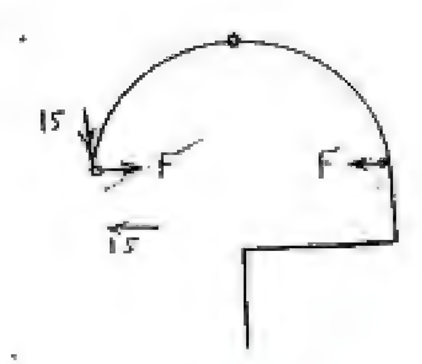
* $\Sigma M_A = 0.0$

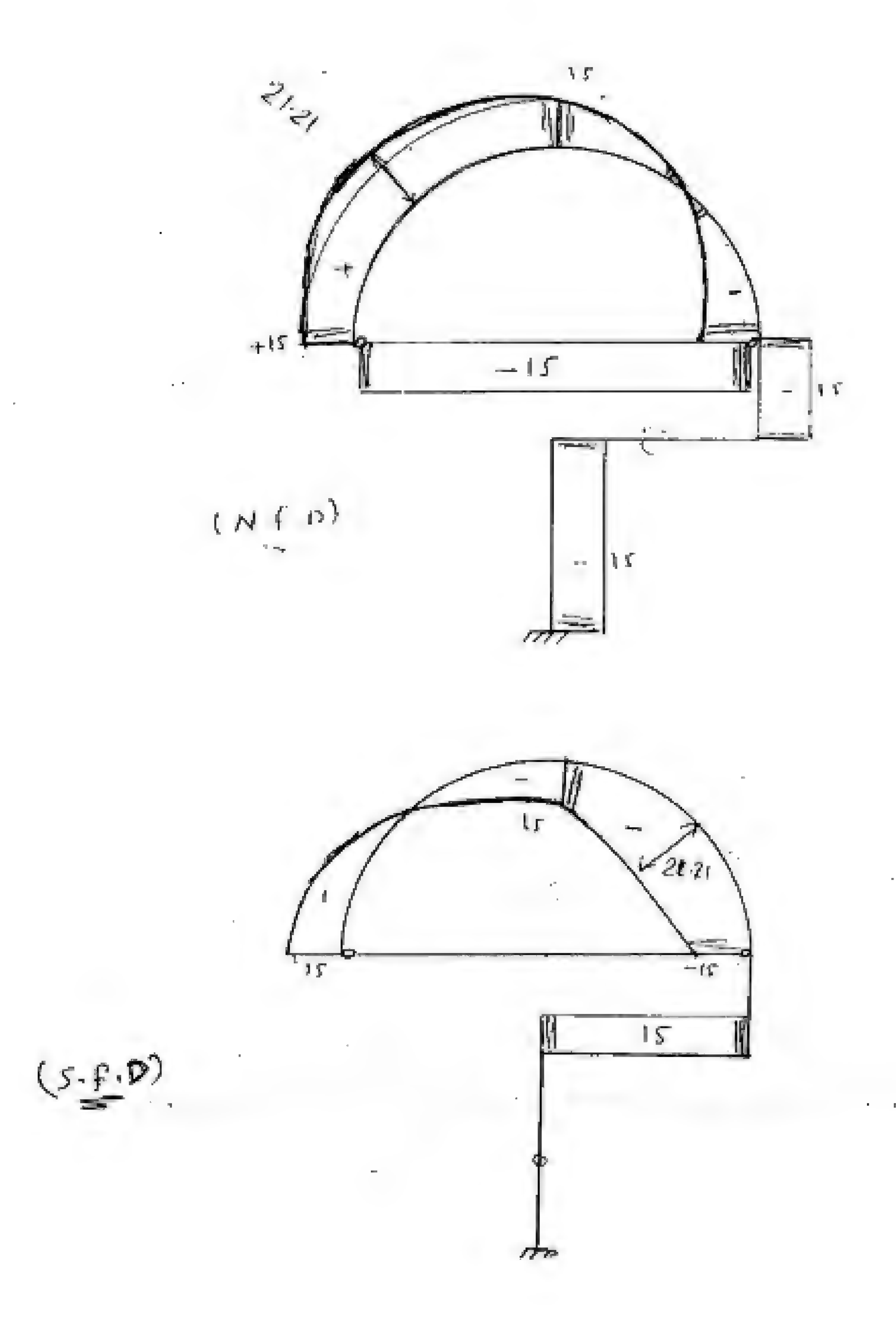
$M_A = 15 * 4 = 60 \ t.m.$

* $\Sigma M_{C_L} = 0.0$

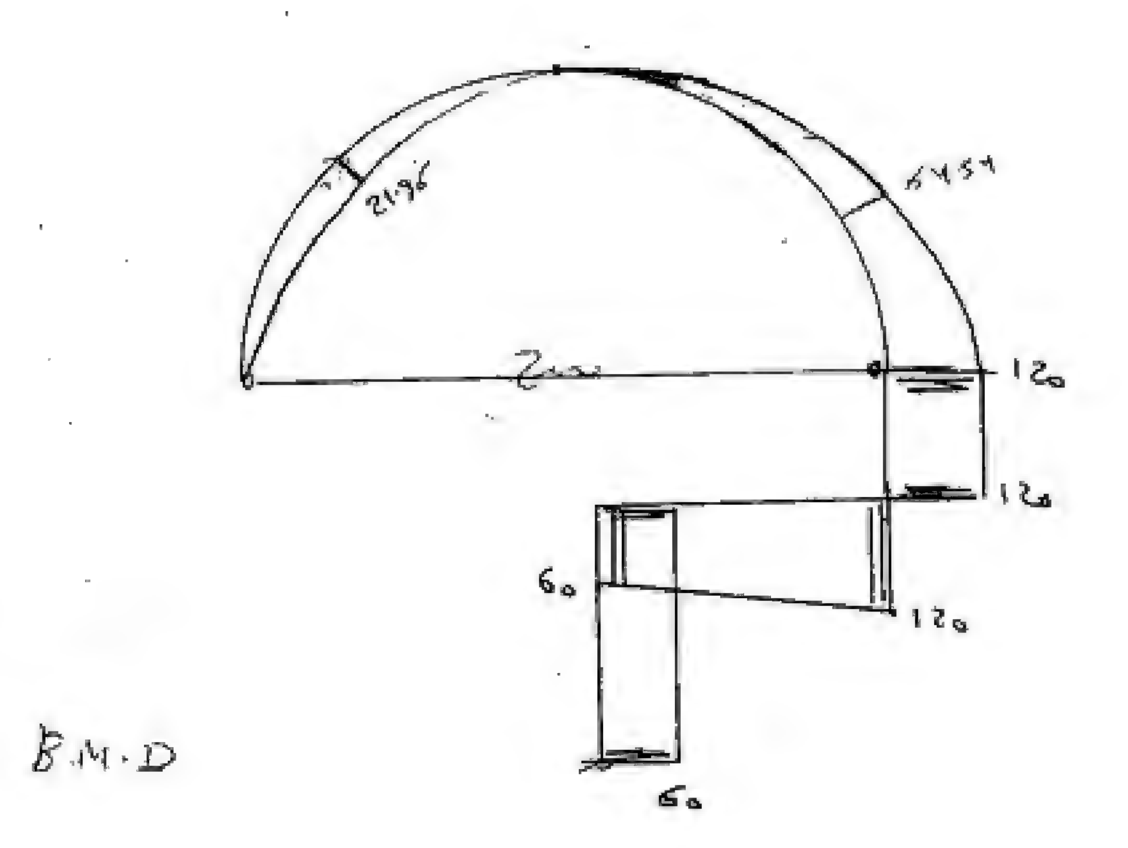
$F * 4 + 15 * 4 = 0.0$

$F = -15 \ t$

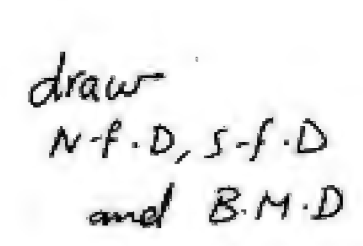


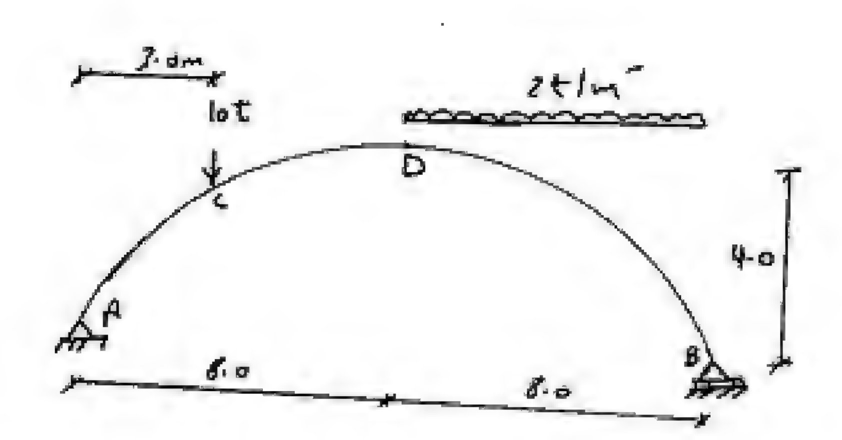


21.21
15
+
-
+15
-15
15
(N.F.D)
15
-
15
15
-
28.21
15
-15
15
(S.F.D)



B.M.D





— Sol —

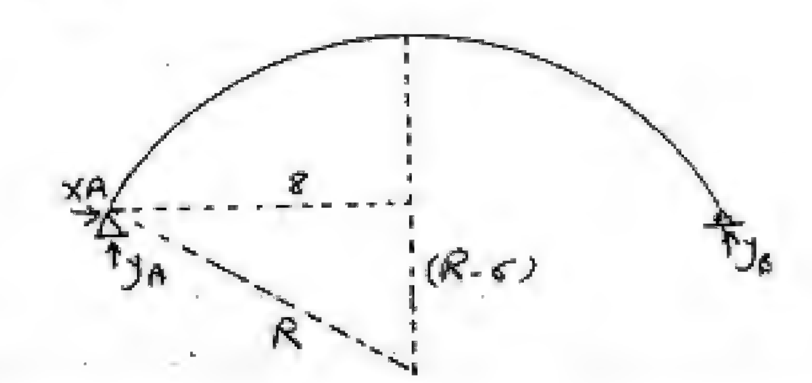
Finding (R)

$$R^2 = (R-h)^2 + (L/2)^2$$

$$R^2 = R^2 - 8R + 16 + 64$$

$$R = 10\ m$$

For Reactions



$\Sigma F_x = 0.0$

$\Rightarrow XA = 0.0$

$\Sigma M_A = 0.0$

$$10 * 3 + 16 * 12 - Y_B * 16 = 0.0$$

$\Rightarrow Y_B = 13.875$ ton

$\Sigma y = 0.0$

$\Rightarrow Y_A = 12.125$ ton

θ at point A $\Rightarrow \sin^{-1}\left(\frac{8}{10}\right) = 53.13^\circ$

θ at point (c) $\Rightarrow \sin^{-1}\left(\frac{5}{10}\right) = 30^\circ$

θ at point (D) $\Rightarrow 0.0$

From A ⟶ C   From $\theta = 53.13^\circ \Rightarrow \theta = 30$

12.125

12.125

* $N = -12.125 \sin\theta$

$N_A = -12.125(\sin 53.13) = -9.7$ t

$N_c = -12.125[\sin 30] = -6.06$ t

* $S.F = +12.125 \cos\theta$

$S.F_A = +12.125(0.6) = 7.275$ t

$S.F_C = +12.125(0.866) = 10.5$ t

* $B.M_A = 0.0$

$BM_c = 12.125 * 3 = 36.375$

From c → d

$\theta = 30 \longrightarrow \theta = 0.0$

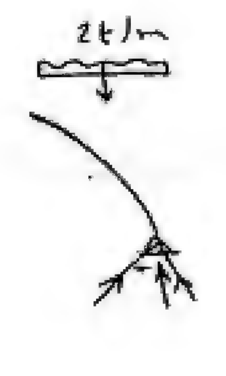
$$N = -2.125 \sin\theta$$

$$\begin{cases} N_c = -1.06 \\ N_d = 0.0 \end{cases}$$

$$S.F = 2.125 \cos\theta$$

$$\begin{cases} Sf_c = 1.84 \\ Sf_d = 2.125 \end{cases}$$

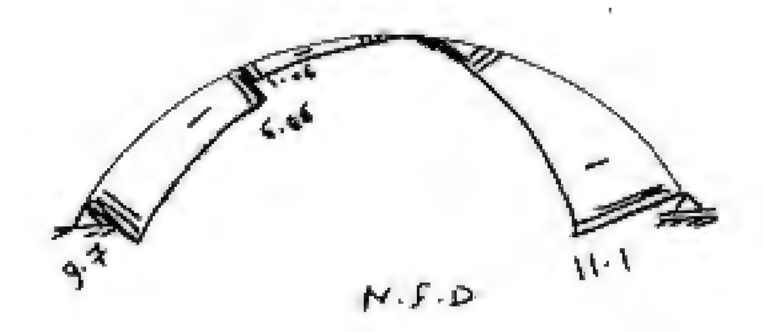
$$B.M_d = 12.125 * 8 - 10 * 5 = 47 \ t.m$$

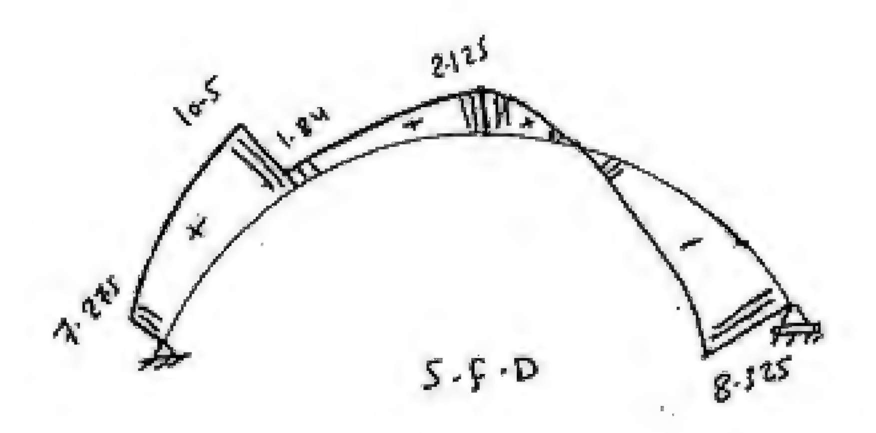


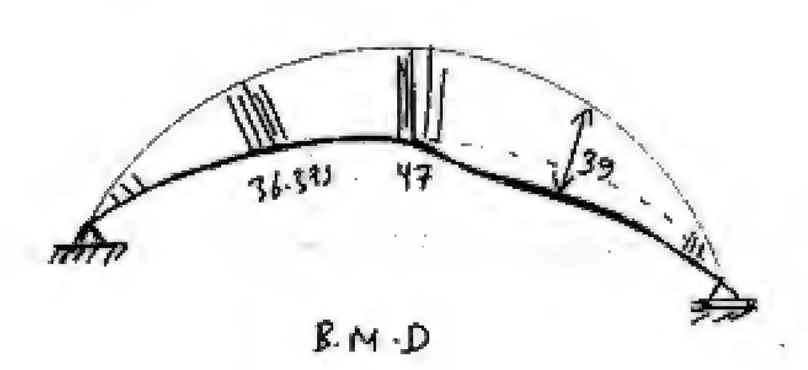
From d → B

$$\begin{cases} N_d = 0.0 \\ N_B = -17.875 \sin(53.13) = -11.1 \end{cases}$$

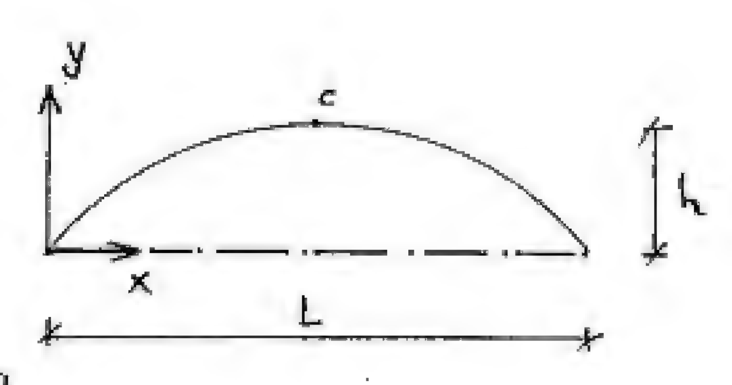
$$\begin{cases} S.F)_d = 1.84 \\ S.F)_B = -17.875 * \cos(53.13) = -8.325 \end{cases}$$


1.66
5.66
9.7
11.1
N.F.D


10.5
1.84
2.125
7.285
S.F.D
8.325


36.375
47
39
B.M.D





$$y = ax^2 + bx + c$$

Req a, b, c

* at $x = 0.0 \Rightarrow y = 0.0$

$\therefore \Rightarrow c = 0.0$

* at $x = L \Rightarrow y = 0.0$

$\therefore \quad 0.0 = aL^2 + bL$

$\therefore \quad b = -aL$

at $x = \frac{L}{2} \Rightarrow y = h$

$$\Rightarrow h = a\left(\frac{L}{2}\right)^2 + b\,(L/2)$$

$$h = a\,\frac{L^2}{4} - \frac{aL^2}{2}$$

$$\Rightarrow \boxed{h = -\frac{aL^2}{4}}$$

$$\Rightarrow \boxed{a = -\frac{4h}{L^2}}$$

$$\Rightarrow \boxed{b = \frac{4h}{L}}$$

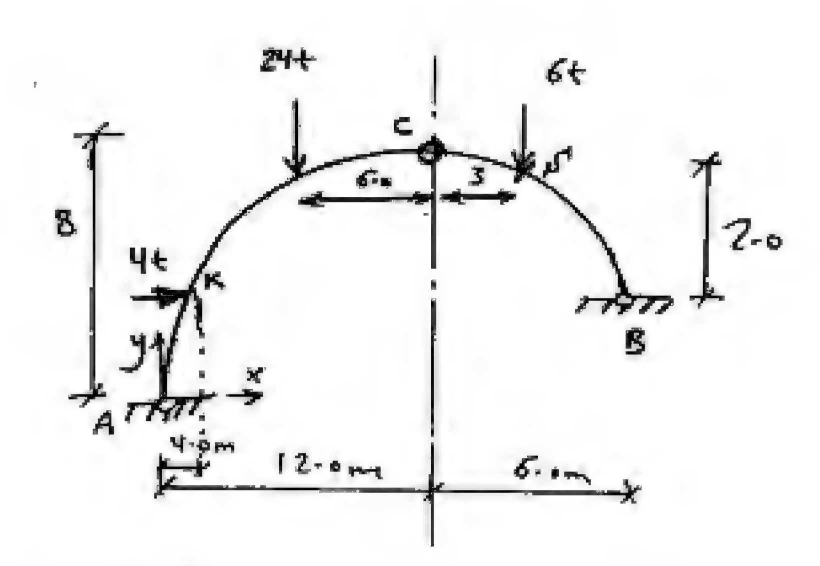
$$\therefore \quad \boxed{y = -\frac{4h}{L^2}\cdot x^2 + \frac{4h}{L}\cdot x}$$

$$\boxed{y = +\frac{4h}{L}\left[x - \frac{x^2}{L}\right]}$$

$$\tan\theta = \frac{dy}{dx} = \frac{4h}{L}\left[1 - \frac{2x}{L}\right]$$

[illegible] θ

Example



Required :-

N.F, B.M, S.F at section S'

— Sol —

$$y = a x^2 + b x + c$$

* at $x = 0.0 \Rightarrow y = 0.0$

$$\Rightarrow C = 0.0$$

* at $x = 18 \Rightarrow y = 6.0\ m$

$$\Rightarrow 6.0 = a(18)^2 + b(18)$$

$$\Rightarrow b = \frac{1}{3} - 18a$$

* at $x = 12 \Rightarrow y = 8.0$

$$8 = a(12)^2 + \left(\frac{1}{3} - 18a\right)(12)$$

$$8 = 144a + 4 - 216a$$

$$\Rightarrow 72a = -4$$

$$\Rightarrow \boxed{a = -\frac{1}{18}}$$

$$\therefore b = \frac{1}{3} + \frac{18}{18} = +\frac{4}{3}$$

$$\therefore \boxed{y = -\frac{1}{18}x^2 + \frac{4}{3}x}$$

for point k $\Rightarrow x = 4.0 \Rightarrow y = 4.44\ m$

for point S' $\Rightarrow x = 15.0 \Rightarrow y = 7.5\ m$

Reactions

$\Sigma M_{c_R} = 0.0$

$$6 * 3 + X_B * 2 - y_B * 6 = 0.0$$

$$\Rightarrow 2X_B - 6y_B = -18 \longrightarrow (1)$$

$* \sum M_A = 0.0$

$$4 * 4.44 + 24 * 6 + 6 * 15 - X_B * 6 - Y_B * 18 = 0.0$$

$$6 X_B + 18 Y_B = 251.78 \longrightarrow (2)$$

By solve (1) & (2)

$$X_B = 16.48 \text{ ton}$$

$$Y_B = 8.5$$

$\sum X = 0.0 \Rightarrow X_A = 12.48$

$\sum Y = 0.0 \Rightarrow Y_A = 21.5$

<u>at section S' (X = 15)</u>

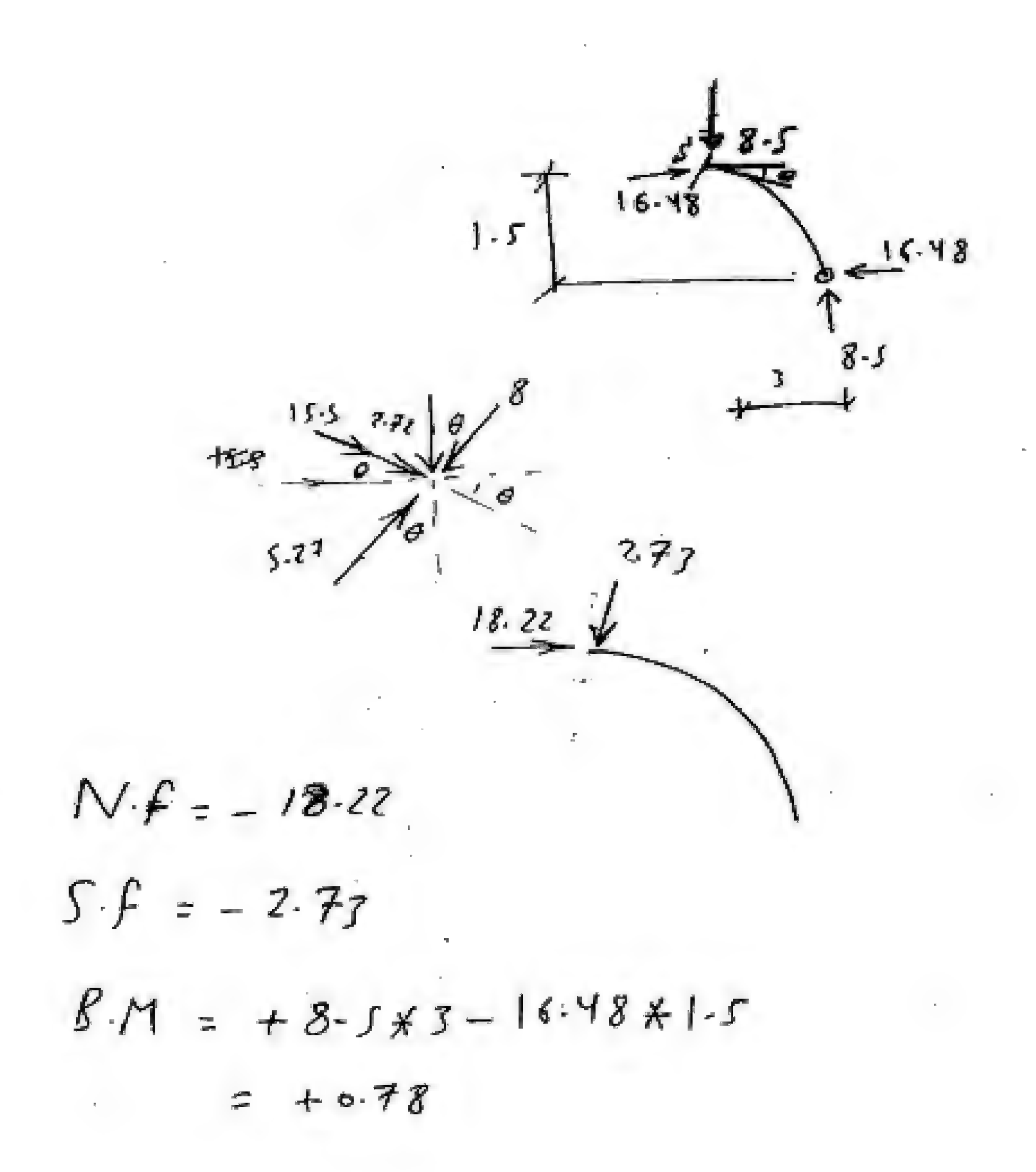
$$\tan\theta = \frac{dy}{dx} = -\frac{2}{18} X + \frac{4}{3}$$

$$= -\frac{2}{18}(15) + \frac{4}{3} = -\frac{1}{3}$$

$\therefore \theta = -18.4 \Rightarrow \cos\theta = 0.94$

$\sin\theta = 0.32$





$$N.F = -18.22$$

$$S.F = -2.73$$

$$B.M = +8.5 * 3 - 16.48 * 1.5$$

$$= +0.78$$

★ Revision ★

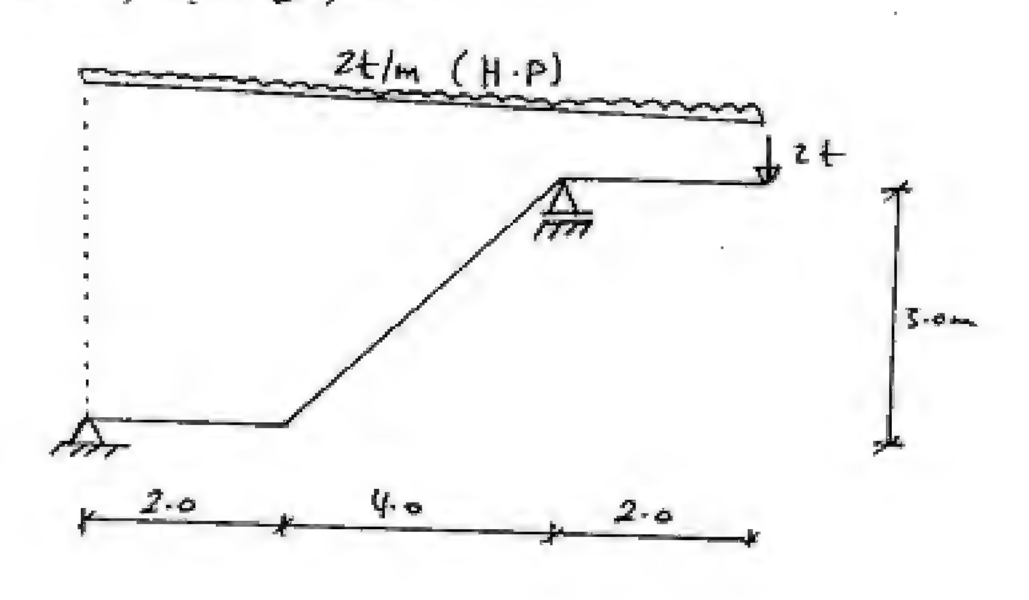


بسم الله الرحمن الرحيم

beams

[1] For the fillowing beam draw

N.F.D , S.F.D , B.M.D :—



— Sol —

16t
4.0m
2t
Y_b
X_a
Y_a

Reactions

$\Rightarrow \Sigma X = 0.0$

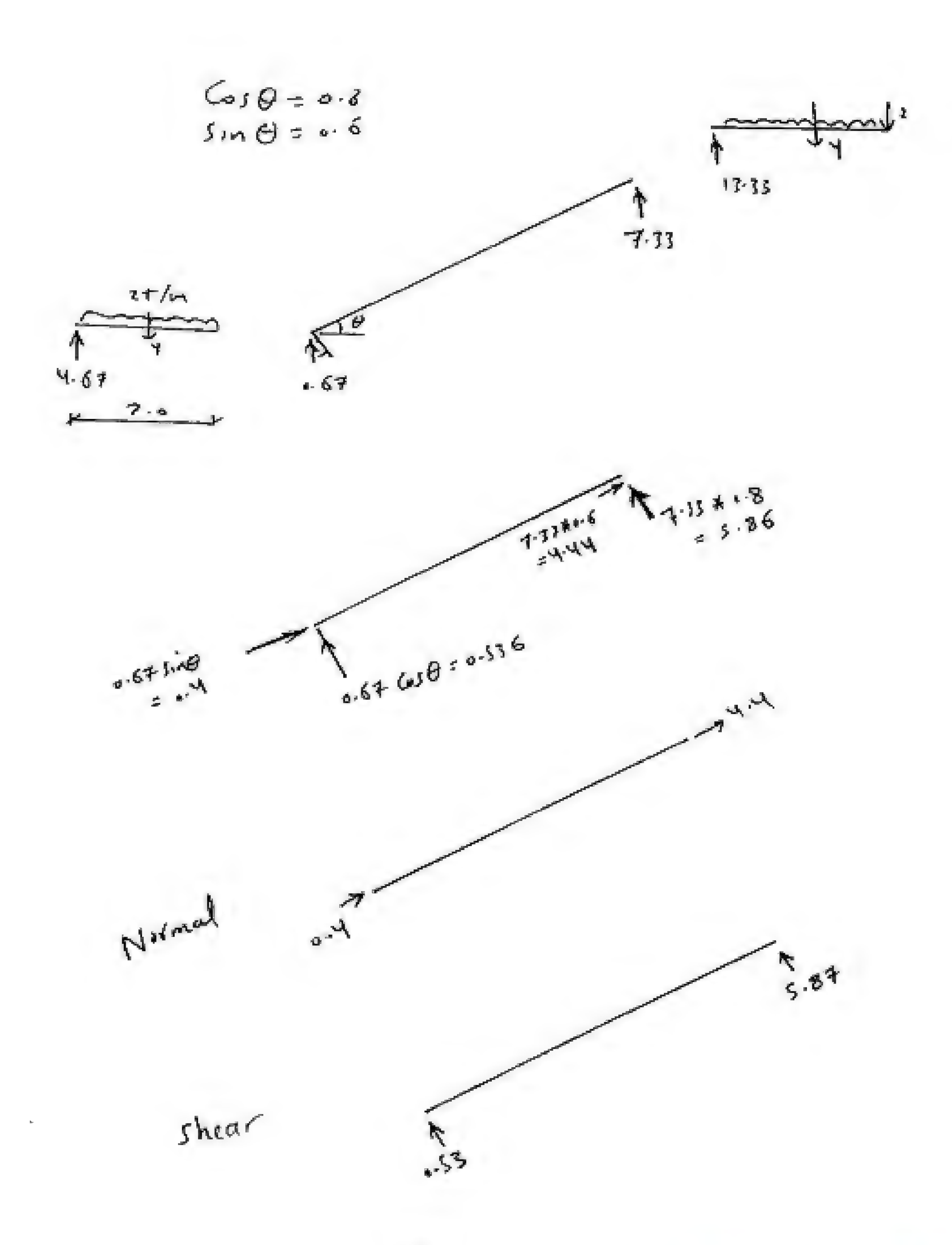
$X_a = 0.0$

$\Rightarrow \Sigma M_A = 0.0$

$16 * 4.0 + 2 * 8 = Y_b * 6$

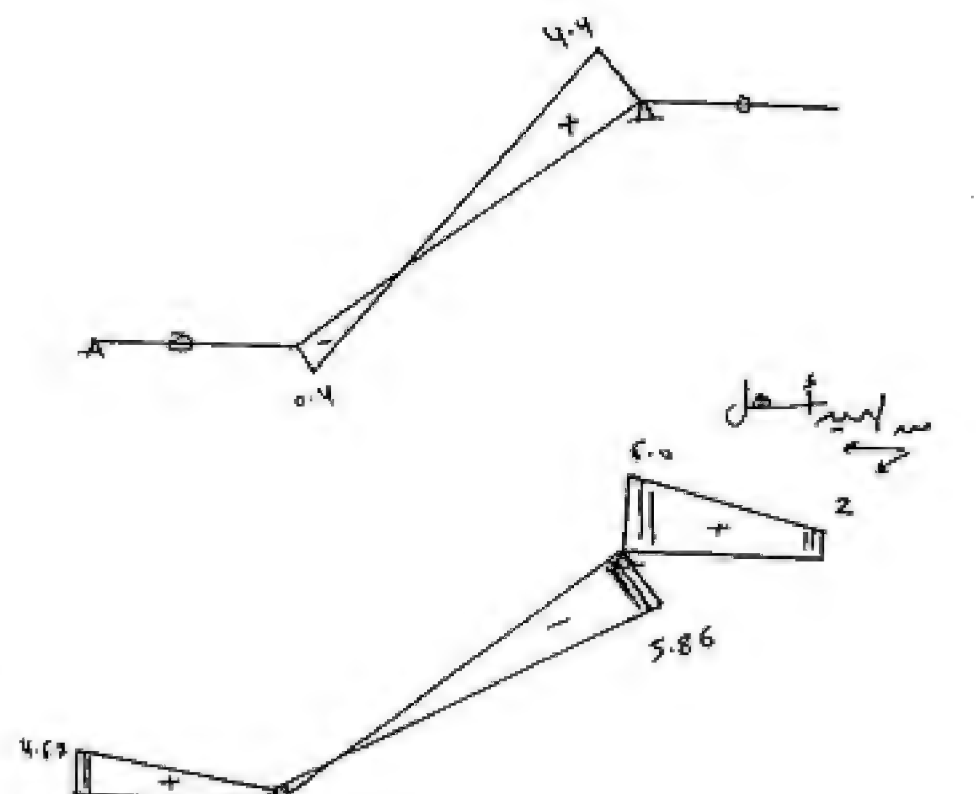
$\Rightarrow Y_b = 13.33 \text{ ton}$

$\Rightarrow \Sigma Y = 0.0 \qquad Y_a + 13.33 = 18 \Rightarrow Y_a = 4.67 \text{ ton}$


Cos θ = 0.8
Sin θ = 0.6
2t/m
4
4.67
7.0
θ
0.67
7.33
4
13.33
7.33*0.6
=4.44
7.33 * 0.8
= 5.86
0.67 sinθ
= 0.4
0.67 Cosθ = 0.536
4.4
Normal
0.4
5.87
Shear
0.53

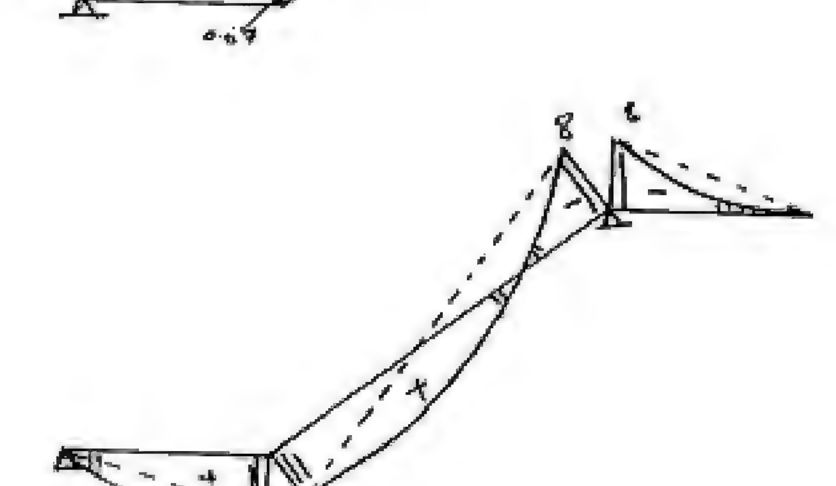
drawings

N.F.D

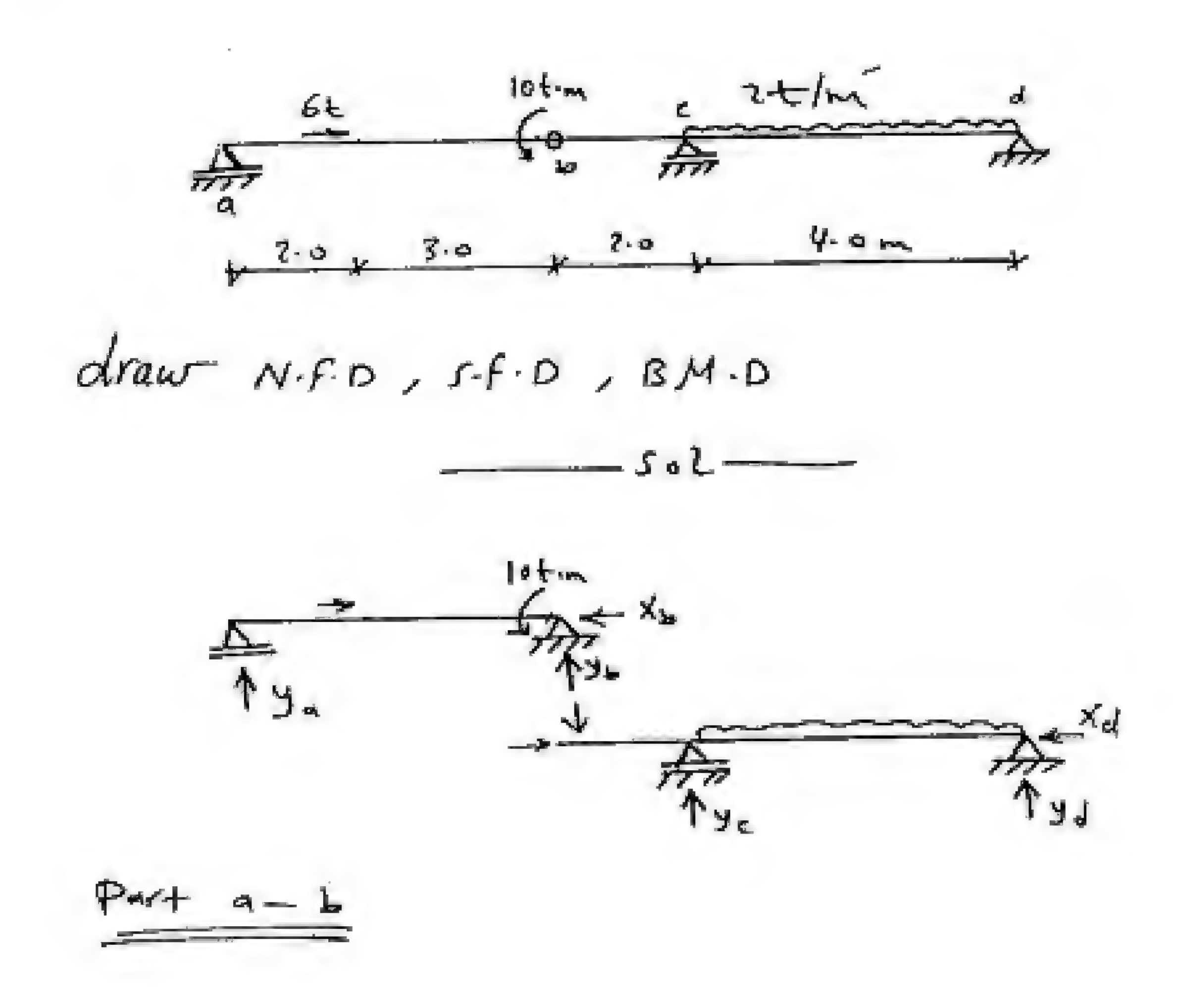


S.F.D

B.M.D



[2]



draw N.F.D , S.F.D , B.M.D

——— Sol ———

Part a – b

6 10t.m $X_b = 6$ Y_a 2 2

* $\Sigma X = 0.0$

  $X_b = 6$ ton ←

* $\Sigma M_b = 0.0$

  $\Rightarrow 10 = Y_a * 5$

  $Y_a = 2$ ton ↑

* $\Sigma Y = 0.0$

  $Y_b = 2$ ton ↓

Part bd

6 ← , ↓ 2

8 ; 6 ; 2 ; Xd ; Yc ; Yd ; 2.0 ; 2.0 ; 2.0

$\Rightarrow \Sigma X = 0.0$

$\therefore X_d = 6 \text{ ton} \leftarrow$

$\Rightarrow \Sigma M_d = 0.0$

$8 * 2 = Y_c * 4 + 2 * 6$

$Y_c = 1 \text{ ton} \uparrow$

$\Rightarrow \Sigma Y = 0.0 \quad \therefore Y_d = 5t \uparrow$

drawings

6t ; 10t.m ; 2t/m ; 2 ; 1 ; 5

N.F.D. : −6.0 ; −6.0 ; −6.0

S.F.D : 2 ; (+) ; 1 ; (+) ; (−) ; 5

B.M.D : (+) ; 10 ; 4.0 ; (+)

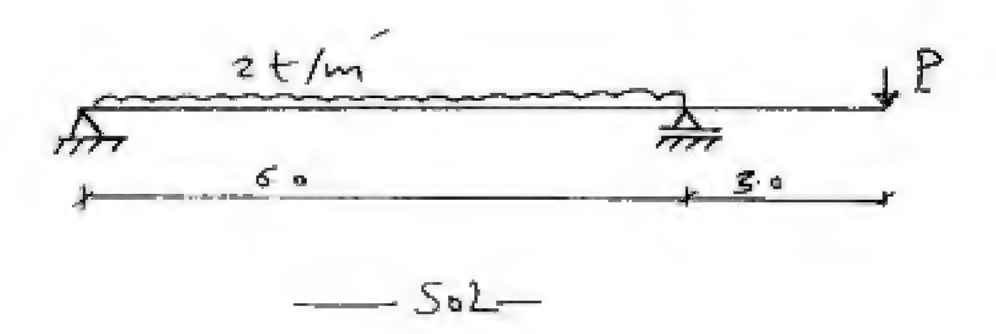
drop بمقدار 10t.m نتيجة العزم

مرة

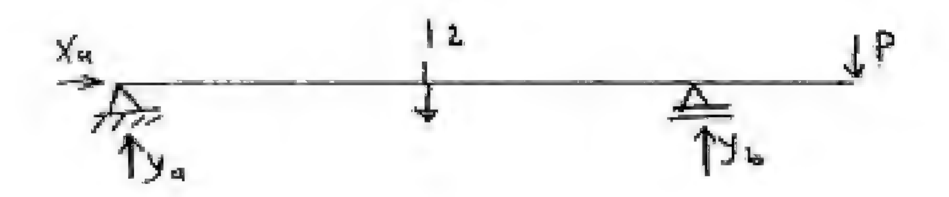
(5)

[1] find the value of P which make

max (+ve) B.M = max (-ve) B.M



— Sol —



<u>Reactions</u>

$\Sigma X = 0.0$

$\Rightarrow X_a = 0.0$

$\Sigma M_a = 0.0$

$\Rightarrow 12*3 + P*9 = Y_b*6$

$\Rightarrow Y_b = 6 + 1.5P$

$\Sigma Y = 0.0$

$\Rightarrow 12 + P = 6 + 1.5P + Y_a$

$\boxed{Y_a = 6 - 0.5P}$

Position of zero shear

2 t/m

P

$6-\frac{P}{2}$

6.0

3.0

x'

$$Q_o = 0.0 = (6-P/2) - 2x'$$

$$x' = 3 - P/4$$

$2x'$

(o)

x'

$(6-\frac{P}{2})$

$$M_o = (6-P/2)\,x' - 2x'^2/2$$

$$= (6-P/2)(3-P/4) - (3-P/4)^2$$

$$= 18 - 1.5P - 1.5P + P^2/8 - [9 - 1.5P + \frac{P^2}{16}]$$

$$Max_{(+ve)} = 9 - 1.5P + P^2/16$$

$$Max_{(-ve)} \text{ at } b = P * 3$$

$\because \quad M_{+ve} = M_{-ve}$

$$9 - 1.5P + \frac{P^2}{16} = 3P$$

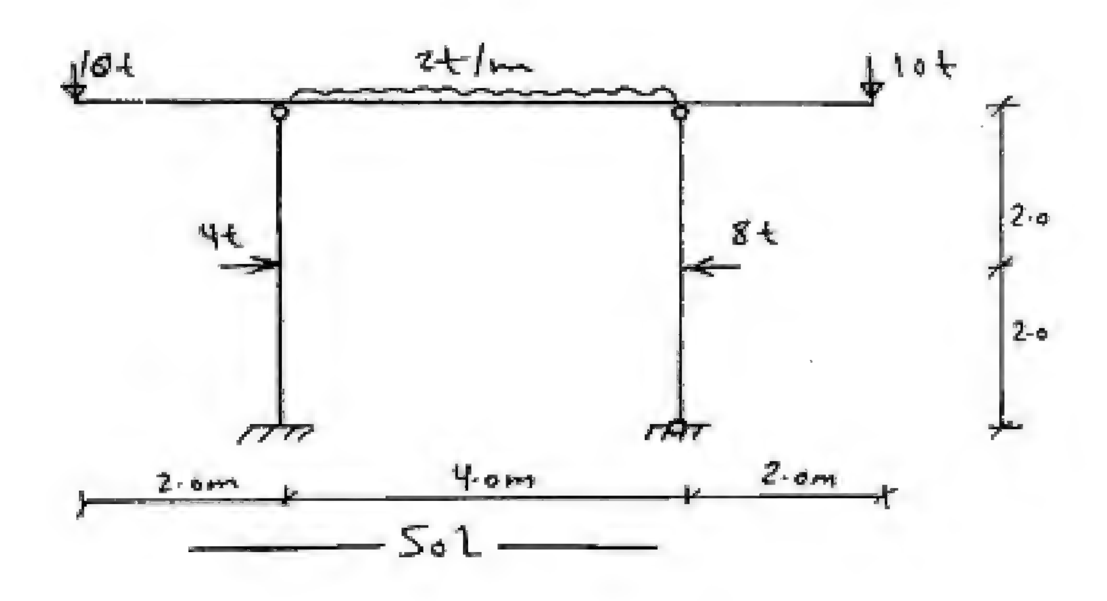
$$\therefore \quad P^2 - 72P + 144 = 0.0$$

$$\Rightarrow \boxed{P = 2.06 \text{ ton}} \qquad \underline{\underline{OK}}$$

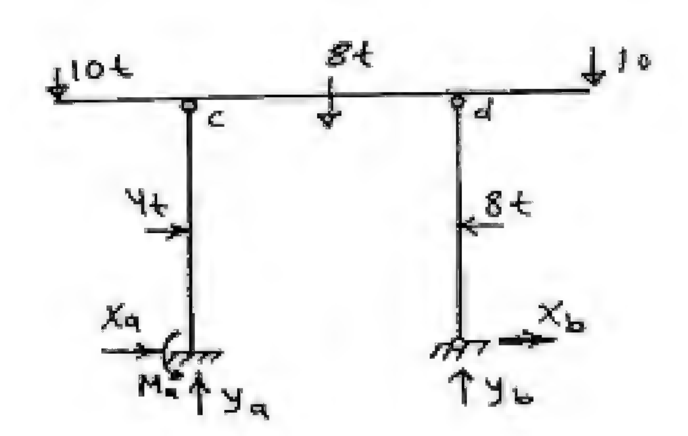
$$\therefore \quad \bar{X} = 3 - \frac{2.06}{4} = 2.485$$

4 For the following frame draw

N.F.D, S.F.D & B.M.D



Sol



* $\sum M_{d\,section} = 0.0$

$$8 \times 2 = X_b \times 4$$

$$\Rightarrow X_b = 4 \text{ ton}$$

$\Rightarrow \underline{\Sigma X = 0.0}$

$\therefore \quad X_a + 4 + 4 = 8$

$\therefore \quad X_a = 0.0$

$\Rightarrow \Sigma M_a = 0.0$

$0.0 = 4*2 + 8*2 + 10*6 - 8*2 - 10*2 - M_a - Y_b*4$

$M_a + 4Y_b = 48 \longrightarrow (1)$

$\Rightarrow \Sigma M_{c\,down} = 0.0$

$4*2 + M_a + \cancel{X_a * 4} = 0.0$ ($X_a \to 0.0$)

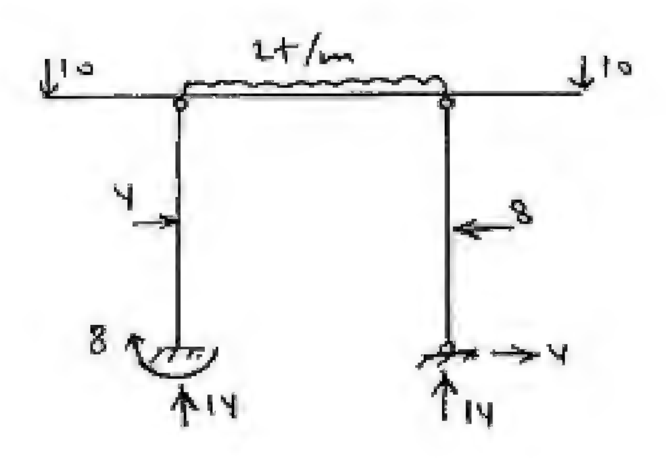
$M_a = -8 \text{ t.m}$

$\therefore \quad -8 + 4\,Y_b = 48$

$Y_b = 14 \text{ ton}$

$\Sigma Y = 0.0 \Rightarrow 10 + 8 + 10 - 14 = Y_a$

$Y_a = 14 \text{ ton}$



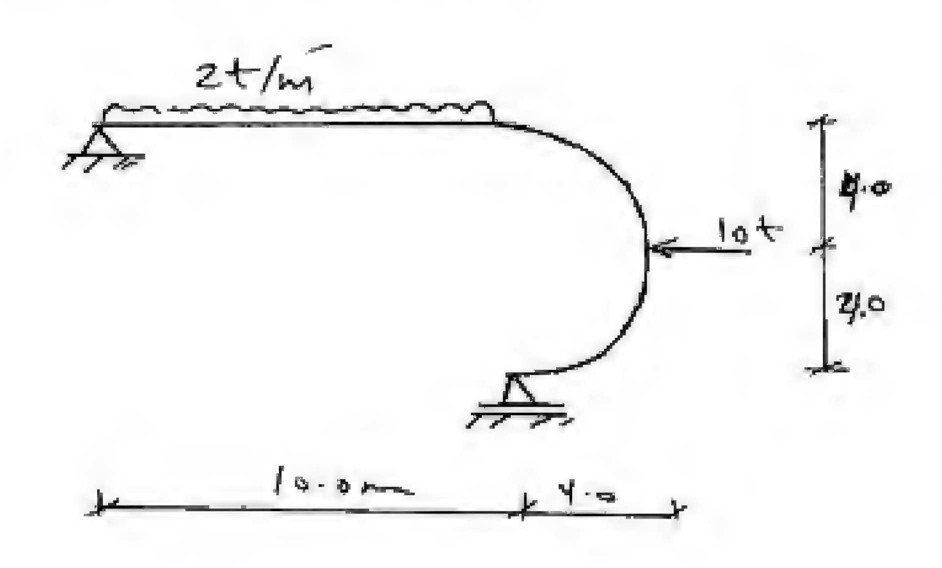
N.F.D

S.F.D

B.M.D

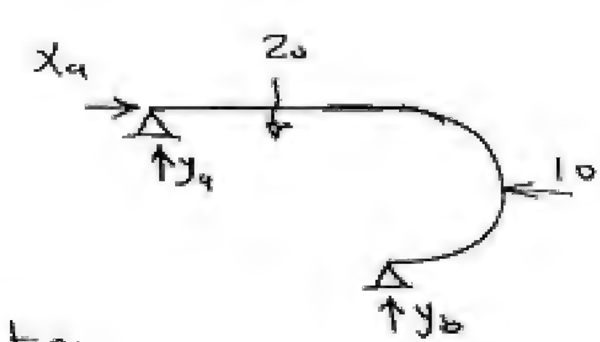
6 For the following Arch draw

S.F.D, N.F.D & B.M.D



— Sol —

Reactions



* $\sum X = 0.0$

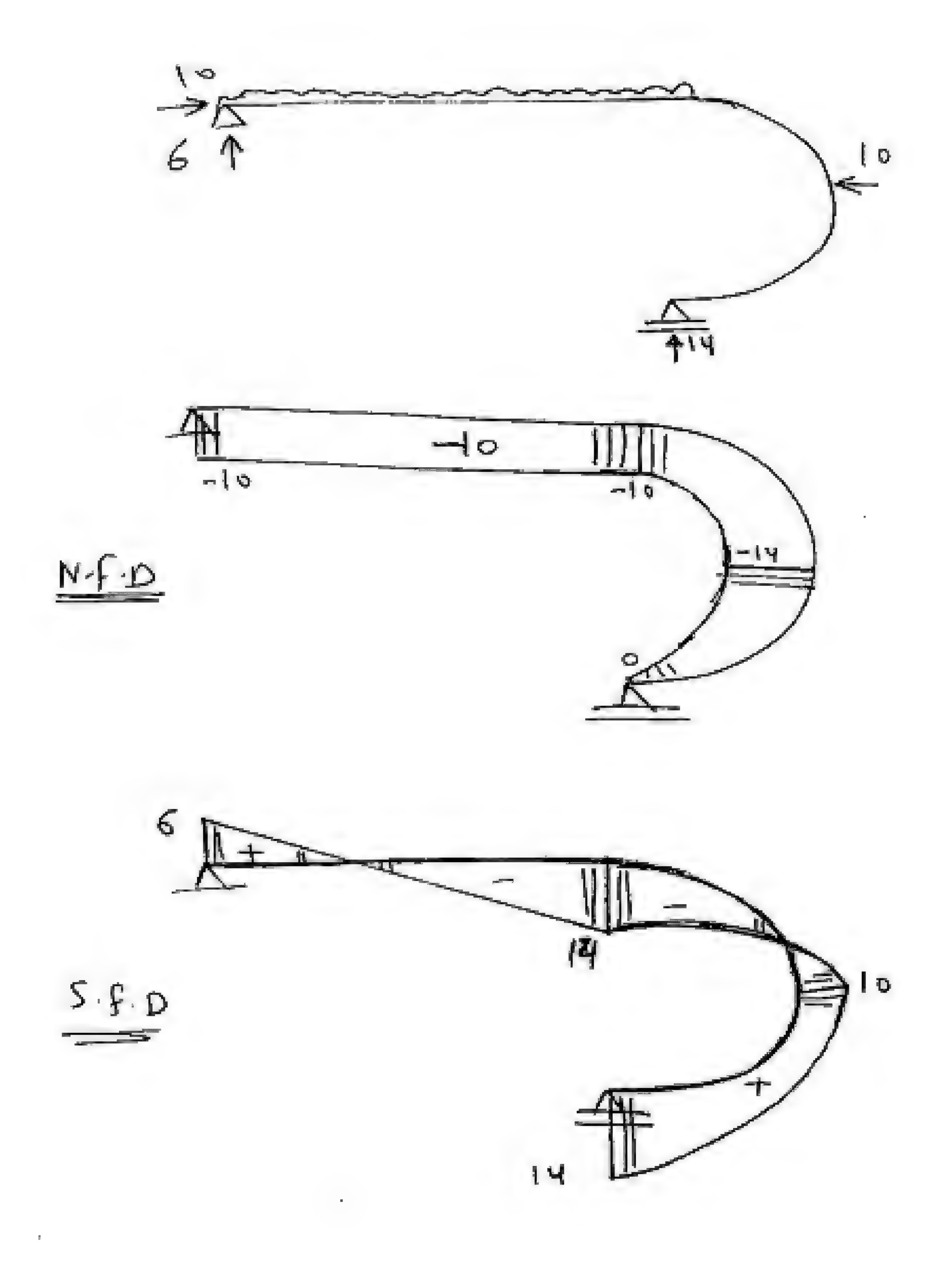
$\Rightarrow X_a = 10$ ton.

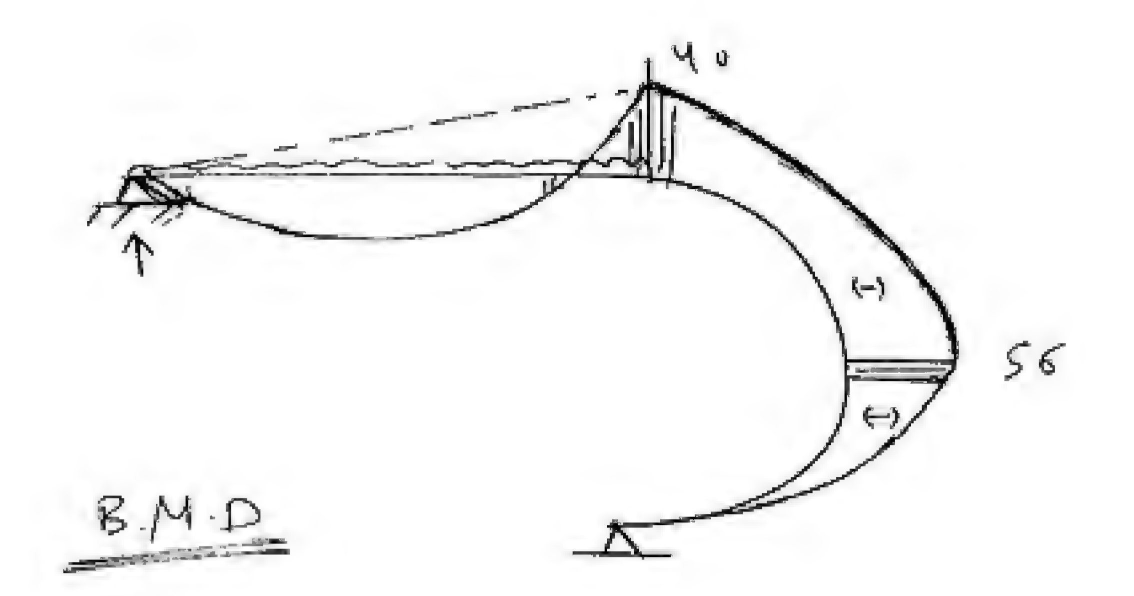
* $\sum M_a = 0.0$

$$20 * 5 + 10 * 4 = y_b \times 10$$

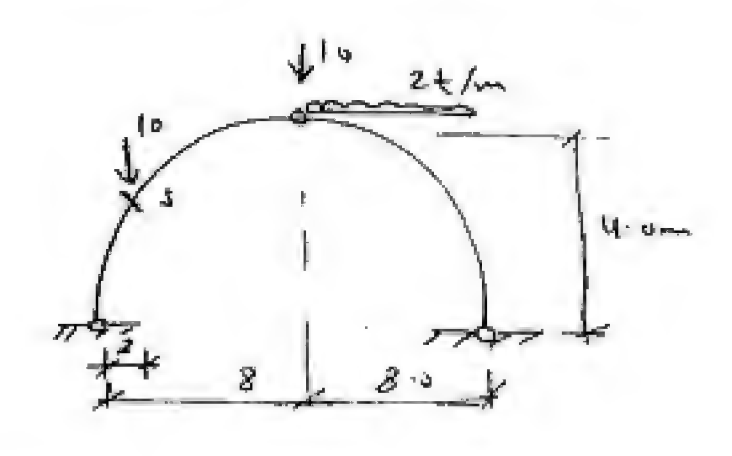
$$y_b = 14 \text{ ton}$$

$\sum y = 0.0 \rightarrow y_a = 6$ ton.


10
6
10
14
-10
-10
-10
N.F.D
-14
0
6
+
-
14
-
10
S.F.D
+
14


40
(-)
56
(-)
B.M.D

[7] for the following Circular Arch find N.F, S.F, B.M at section S



— Sol —

Finding R

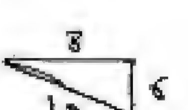
$R^2 = 8^2 + (R-4)^2$

$= 64 + R^2 - 8R + 16$

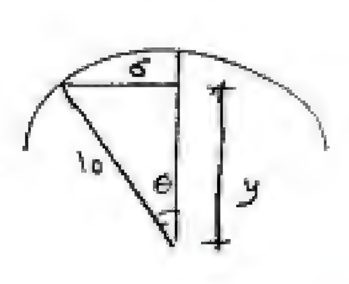
$\therefore 8R = 80 \Rightarrow R = 10\,m.$



$\therefore R - h = 6.0\,m$



Find h & θ



$\therefore y = 8\,m \Rightarrow h = 2\,m$

$\theta = \sin^{-1} 0.6 = 38.86$

finding Reaction

$\Sigma M_a = 0.0$

$\Rightarrow$

$$10*2 + 10*8 + 16*12 = y_b * 16$$

$$\Rightarrow y_b = 18.25 \text{ ton}$$

$\Sigma Y = 0.0 \quad \Rightarrow \quad y_a = 17.75$

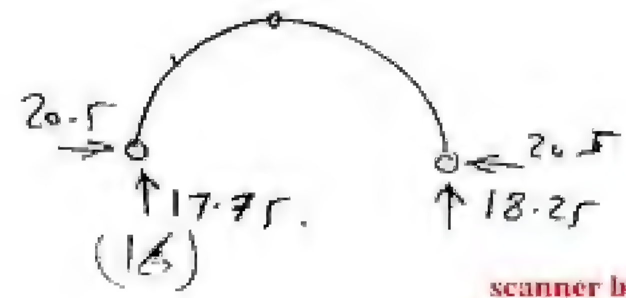
$\Sigma M_{c\,l} = 0.0$

$$10*6 + X_a * 4 = 17.75 * 8$$

$$X_a = 20.5 \text{ ton}.$$

$\Sigma X = 0.0$

$$\Rightarrow \quad X_b = 20.5 \text{ ton}$$



at section

$$N.F = -(17.75 * 0.6 + 20.5 * 0.8)$$
$$= -27.05 \text{ ton}$$

$$S.F = 17.75 * 0.8 - 20.5 * 0.6 = +1.9 \text{ ton}$$

$$B.M = +17.75 * 2 - 20.5 * 2$$
$$= -5.5 \text{ t.m}$$

[8] for the following beam defini it tobe —

Stable or not & determinate or not

and make it Stable & deter—

(i)

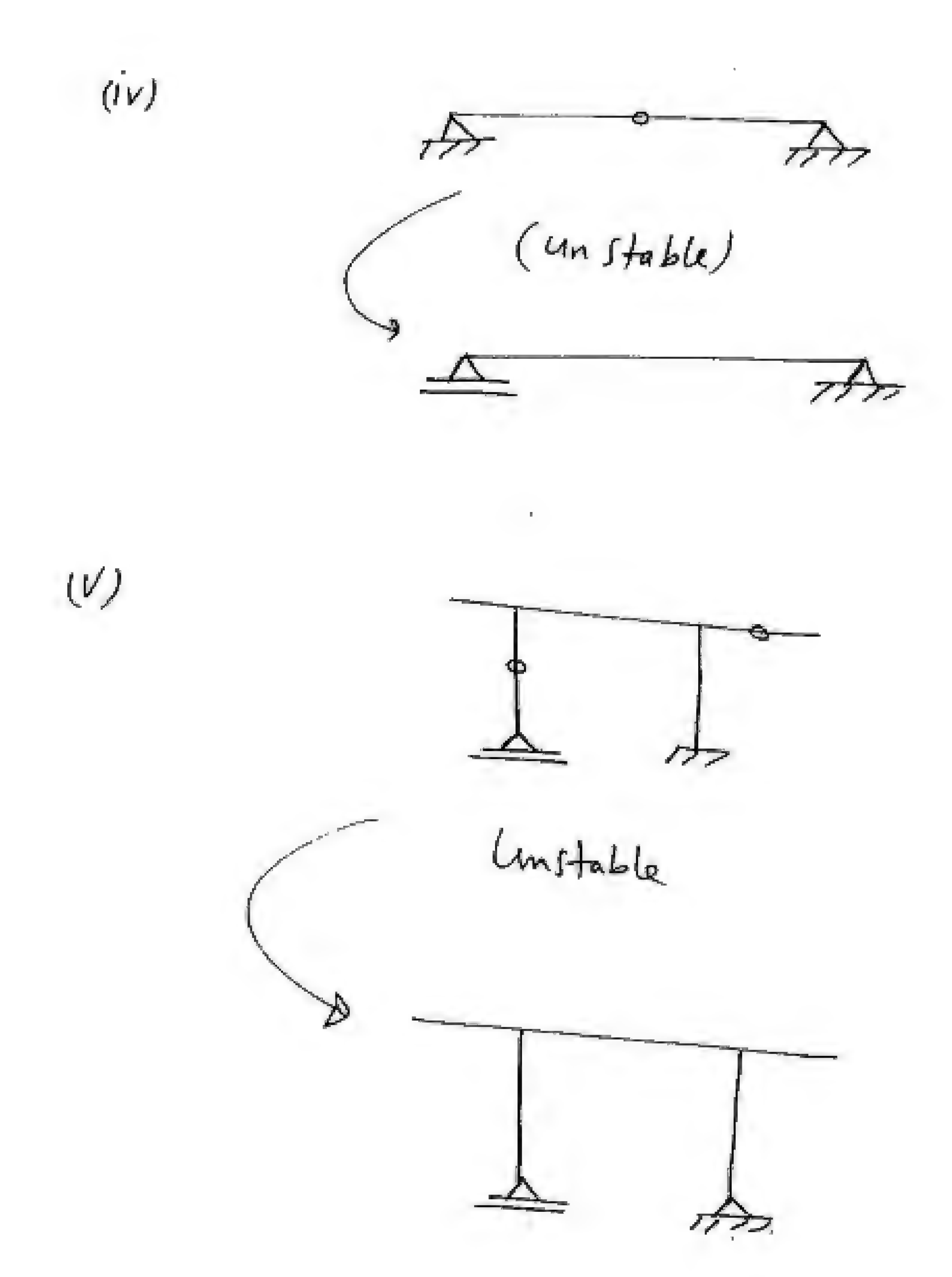
(unstable)

(ii)

(unstable)

(iii)

(iv) Stable & determinate


(iv)
(unstable)
(V)
Unstable



بسم الله الرحمن الرحيم

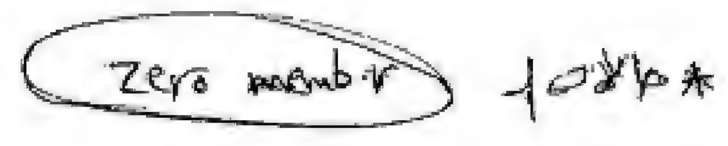
الجمالونات Truss

* تحليل الـ truss يعني إيجاد القوى الداخلية (وهي عبارة عن normal Force فقط.
فعناصر الـ Truss لا تحمل أي نوع من العزوم ولا قوى القص)

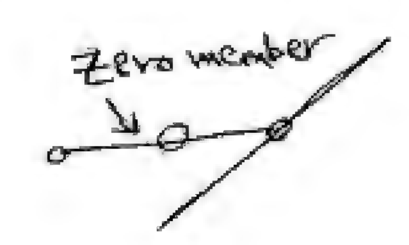
* يعتبر كل عنصر من الـ truss وهو عبارة عن link member

* لإيجاد القوى في الـ truss يوجد بعض العناصر معلومة القيمة = صفر
ويسمى هذا العنصر (Zero member) وعند معرفته يتم إزالته
من الـ Truss ويستخدم لتسهيل الإنشاء

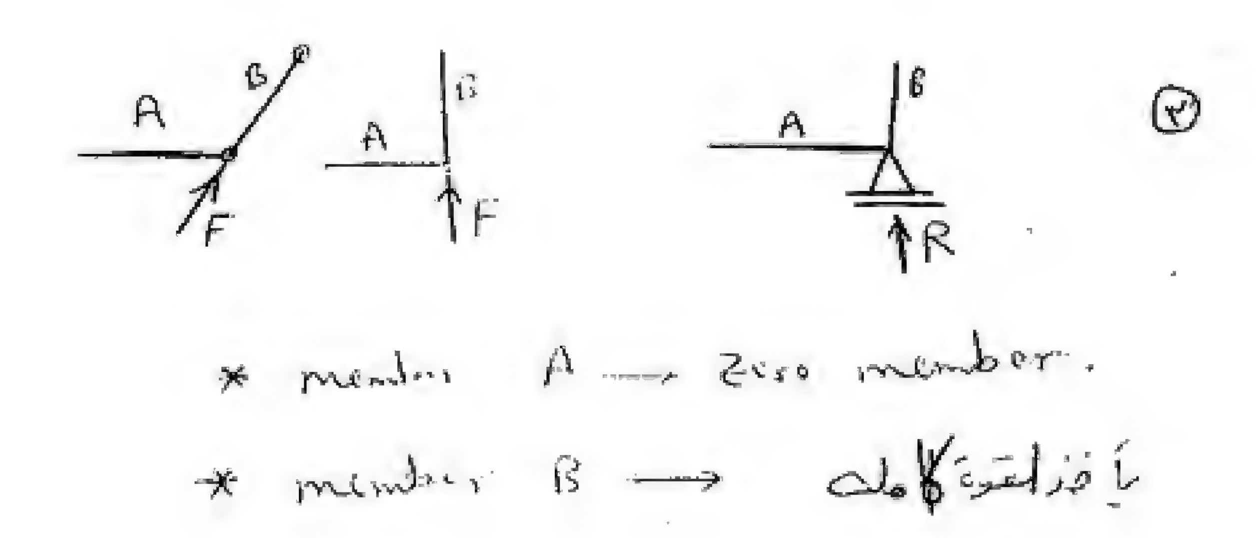
* حالات الـ



① عنصرين على استقامة واحدة
ويخرج ثالث منها ولا يوجد قوى عند هذه الـ joint



② عنصرين مشتركين في نفس الـ joint ولا يوجد تحميل خارجي



* member A → zero member.

* member B → يأخذ القوة كاملة

~

* القوى في العناصر

ضغط

شد

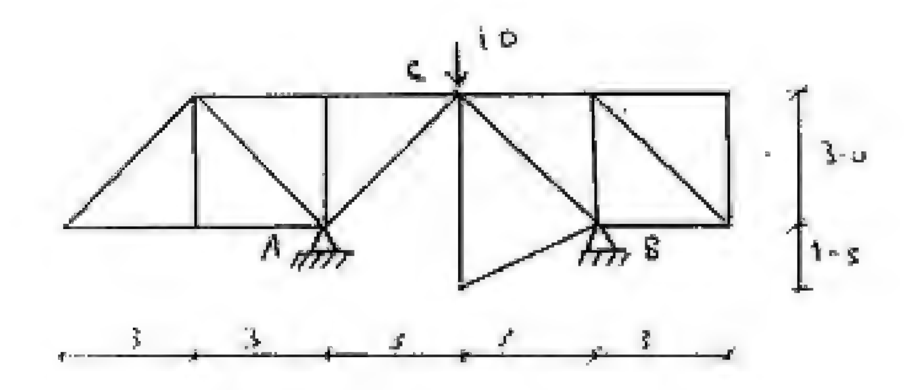
يتم معرفته شد أو ضغط من اتجاهه للـ joint

شد أو ضغط

~

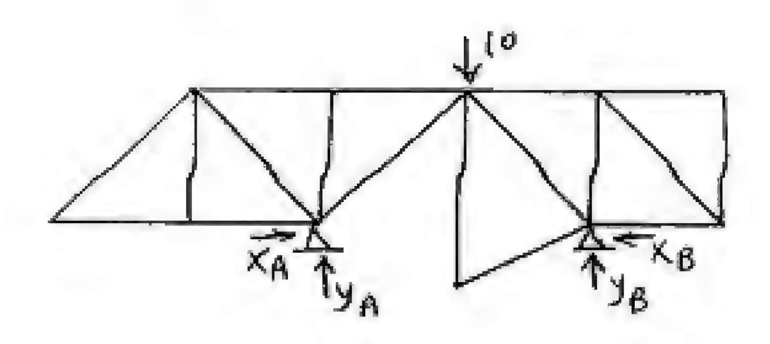
* عند وجود joint خاصة للنشأ تعتبرها intermediate hinge

final 99



find the forces in all member for the following

— sol —



* $\Sigma M_A = 0.0$

$$10 * 3 - Y_B * 6 = 0.0$$

$$\therefore Y_B = 5\,t$$

* $\Sigma M_{C_R} = 0.0$

$$X_B * 3 - Y_B * 3 = 0.0$$

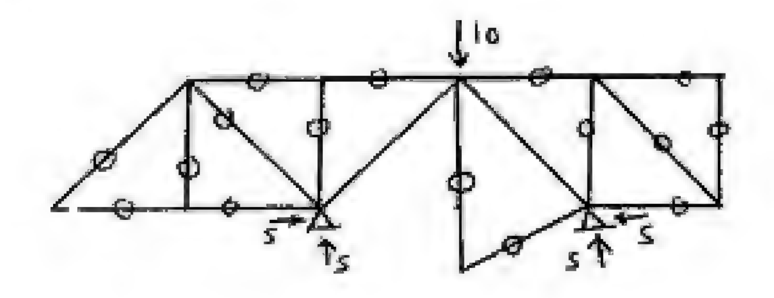
$$\Rightarrow X_B = 5\,ton$$

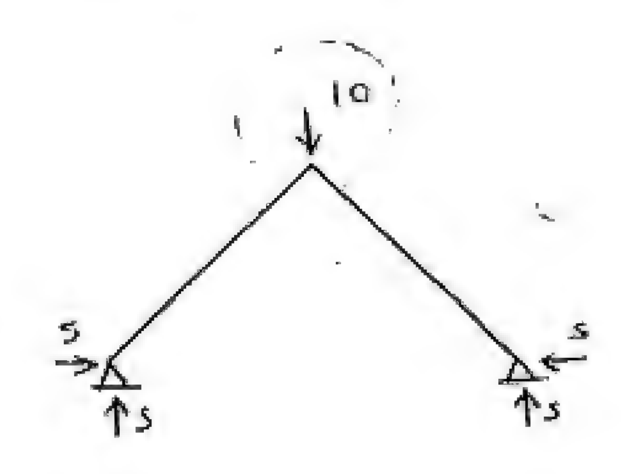
$* \ \Sigma y = 0.0$

$$\Rightarrow y_A = 10 - 5 = 5 \text{ ton}$$

$* \ \Sigma X = 0.0$

$$\Rightarrow X_A = 5 t$$





نعتبر كل الـ joint لها معادلتين

$\Sigma X = 0$

$\Sigma y = 0$

$* \ \Sigma X = 0.0$

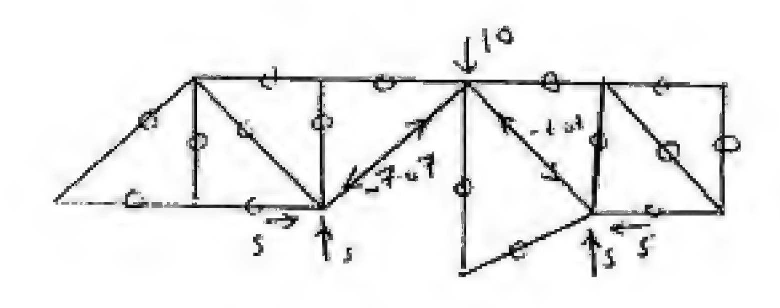
$$F_1 \sin 45 = F_2 \sin 45$$

$$\therefore F_1 = F_2 = F$$

$* \sum y = 0.0$

$\therefore \quad 2 F \cos 45 = 10$

$\therefore F = 7.07$ ton.



All forces.

Final 2010

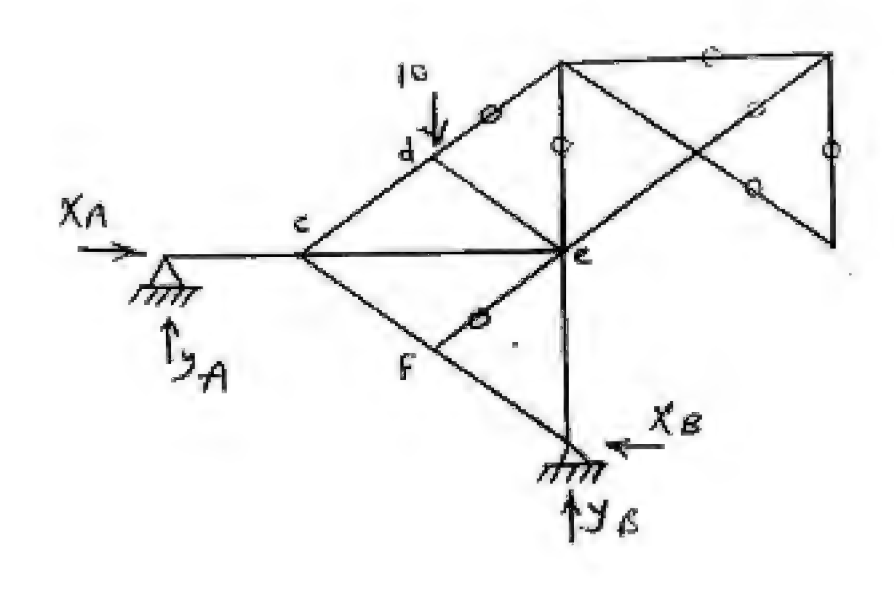
find all member force.

10

1.50 1.50 1.50 1.50

2.00 2.00 2.00 2.00 2.00

—— Sol. ——



Reactions

* $\sum M_{C_L} = Y_A * 2 = 0.0$

$\therefore Y_A = 0.0$

* $\sum Y = 0.0$

$\Rightarrow Y_B = 10\ t \uparrow$

* $\sum M_A = 0.0$

$\Rightarrow 10 * 4 - 10 * 6 + X_B * 3 = 0.0$

$X_B = 6.66\ t \leftarrow$

* $\sum X = 0.0$

$\Rightarrow X_A = 6.66\ t \rightarrow$

Forces

(joint(d))

10

F_2 θ θ F_1

$\sum X = 0.0$

$F_1 \sin\theta = F_2 \sin\theta \Rightarrow F_1 = F_2 = F$

$\Sigma y = 0.0$

$$2 \cdot F \cos\theta = 10$$

$$F = \frac{10}{2 * 0.6} = 8.33 \text{ ton}$$



F_3 θ F_4 8.33 10

$\underline{\Sigma x = 0.0}$

$$F_3 \sin\theta = 8.33$$

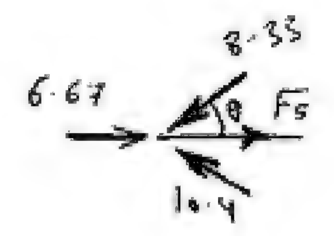
$$F_3 = \frac{8.33}{0.8} = 10.4$$

$\underline{\Sigma y = 0.0}$

$$F_4 + 10.4 \cos\theta = 10$$

$$F_4 = 10 - 10.4 * 0.6 = 3.64$$

joint (c)



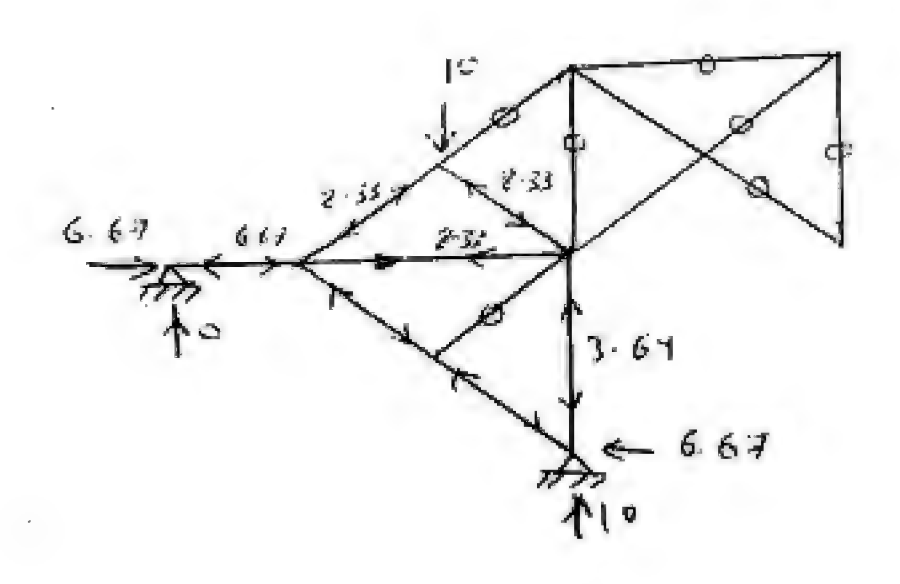
$\Sigma X = 0.0$

$$6.66 + F_s = 8.33 \cos\theta + 10.4 \cos\theta$$

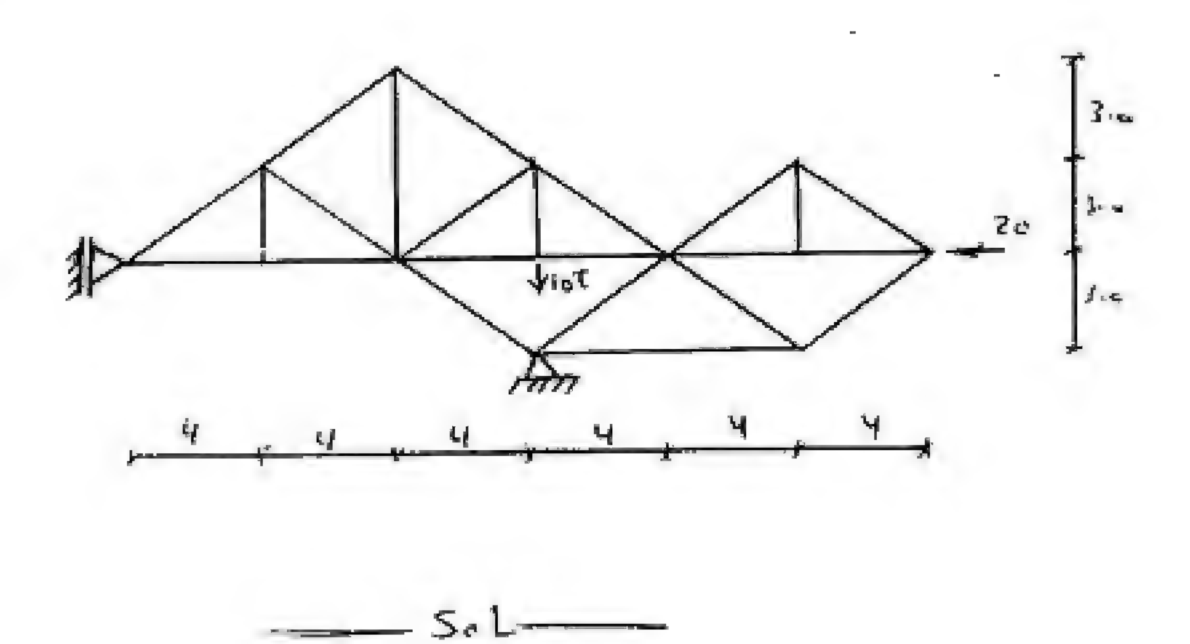
$$= 8.33 * 0.8 + 10.4 * 0.8$$

$$F_s = 15 \text{ ton} - 6.67$$

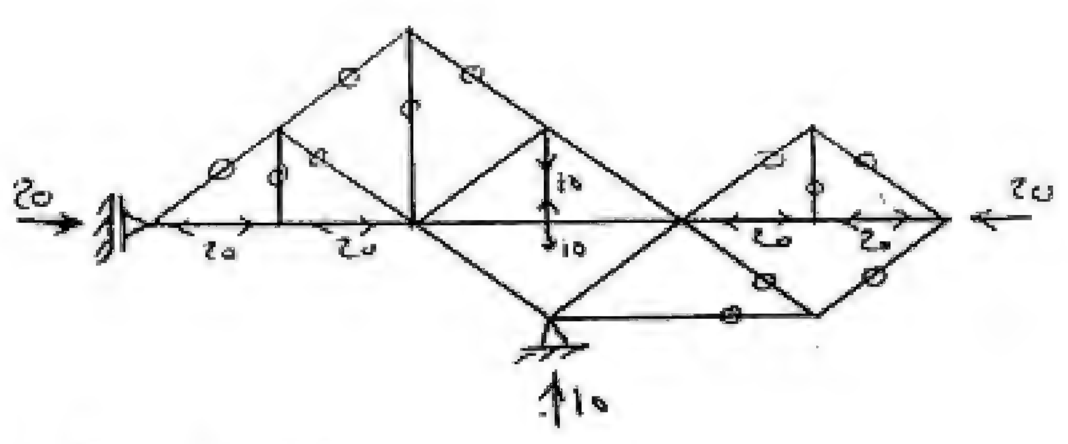
$$= 8.33$$



Final 2002



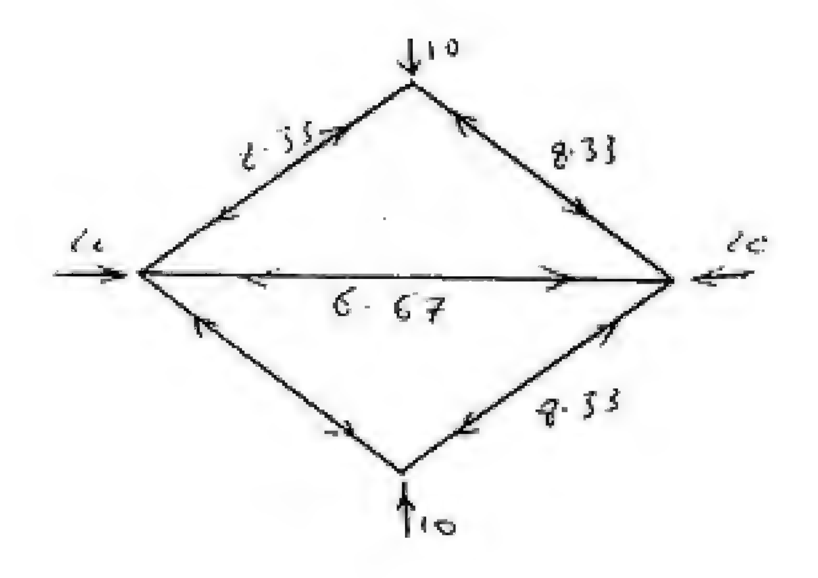
—— Sol ——



لاحظ عندما يكون لدينا

كل استقامة واحدة وآخر يكسرها

فمن اجل قوة تأخذها



$$2F\cos\theta = 10$$

$$F = \frac{10}{2*0.6} = 8.35$$

$$20 = 2*8.33*0.8 + F_2$$

$$F_2 = 6.67$$

Final 2004

B

C

10

A

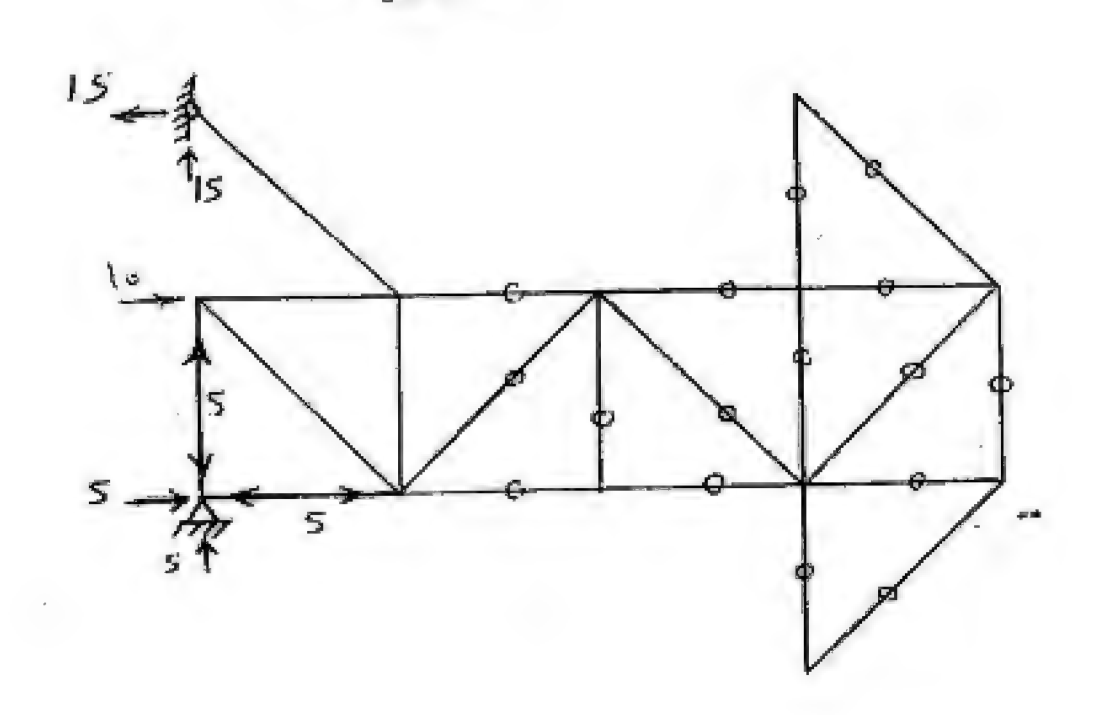
d

24

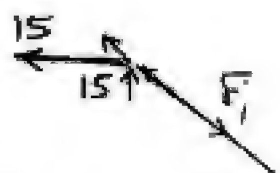
2.0 2.0 2.0 2.0

2.0 2.0 2.0

— sol —

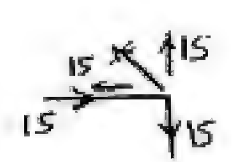


at B

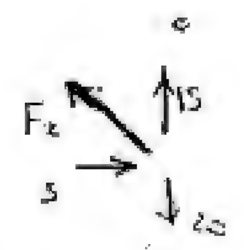


$F_1 = 15 * \cos 45 \times 2 =$

at C

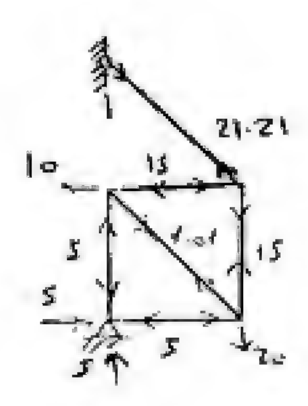


at D



$5 = F_2 \cos 45$

$F_2 = 7.07$

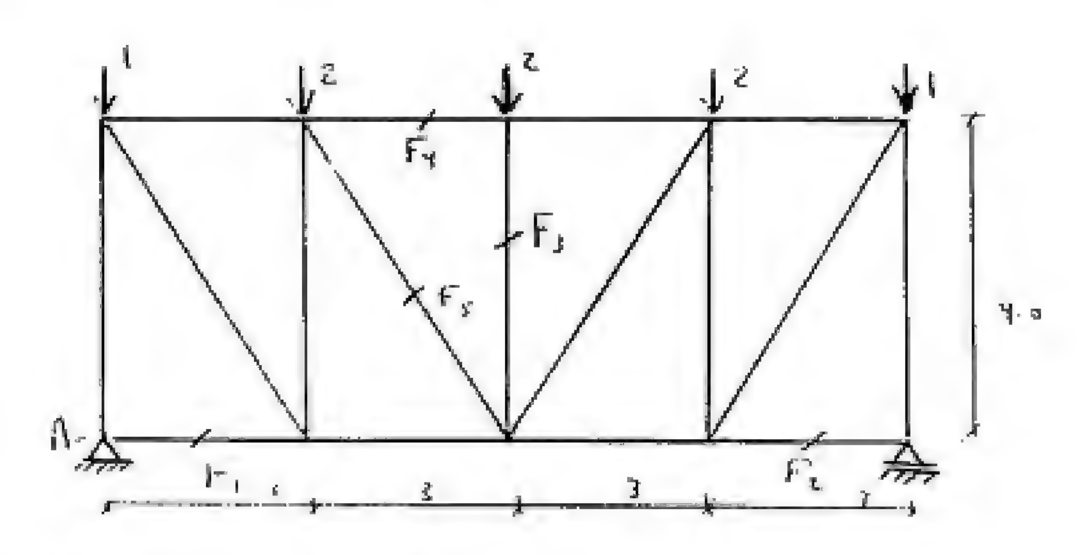


* لاحظ الطريقة التي تم إستخدامها هي طريقة إتزان joint

* هناك طريقة أخرى هي method of sections

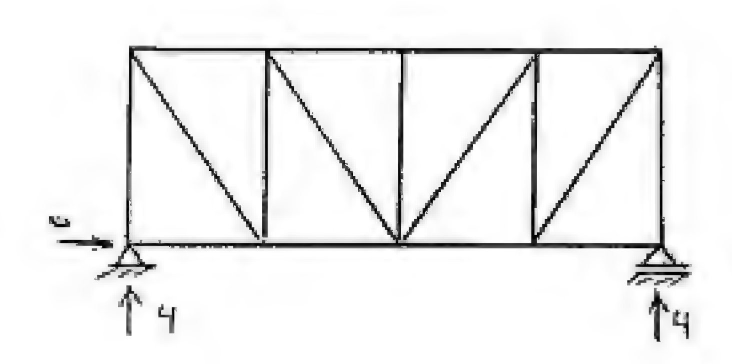
تستخدم هذه الطريقة عندما تكون هناك قوى داخلية ولإختصار الوقت يتم عمل قطاعات .

Example



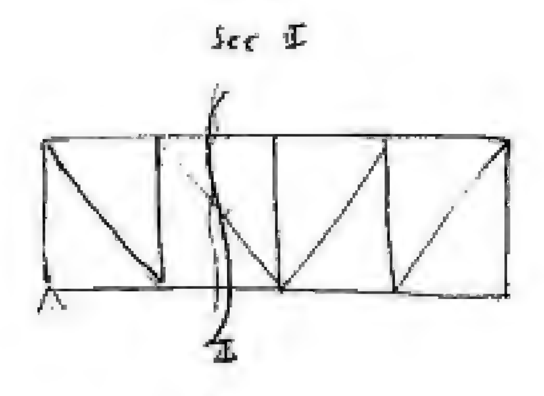
Required F_1, F_2, F_3, F_4, F_5

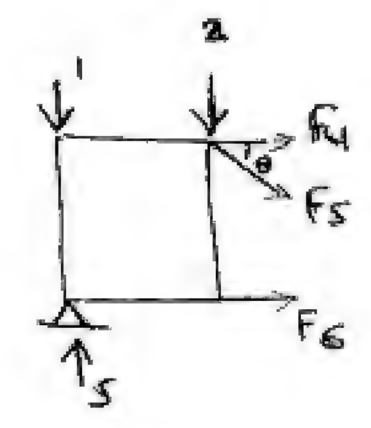
Sol



$F_1 = F_2 = 0.0$

$F_3 = -2$ ton





$\Sigma y = 0.0$

so $F_5 \sin\theta = 5-3$

$F_5 = 2.5$ t

$\Sigma M_A = 0.0$

$2*3 + 2.0 \times 5 + F_4 * 4 = 0.0$

$\Rightarrow F_4 = -3$

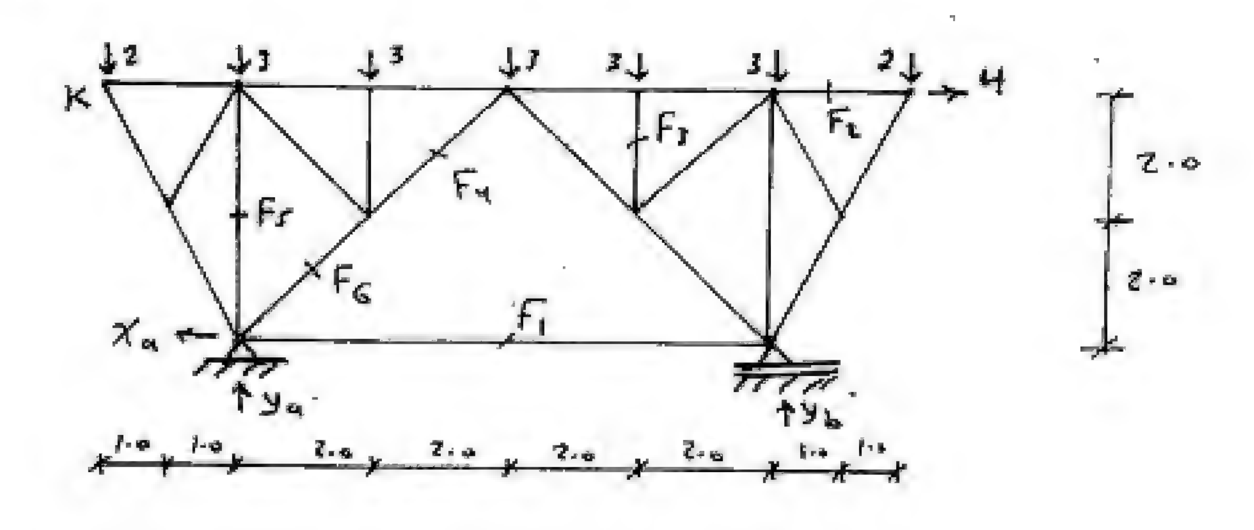
$$\Sigma X = 0\ 0$$

$$3 - 2\ 5 \times 0\ 5 - F_6 = 0\ 0$$

$$F_6 = 1.5$$

$$\xrightarrow{\Sigma X}$$

final 2004



— Sol —

1 Reaction

* $\Sigma X = 0.0$

$$X_a = 4 \text{ ton}$$

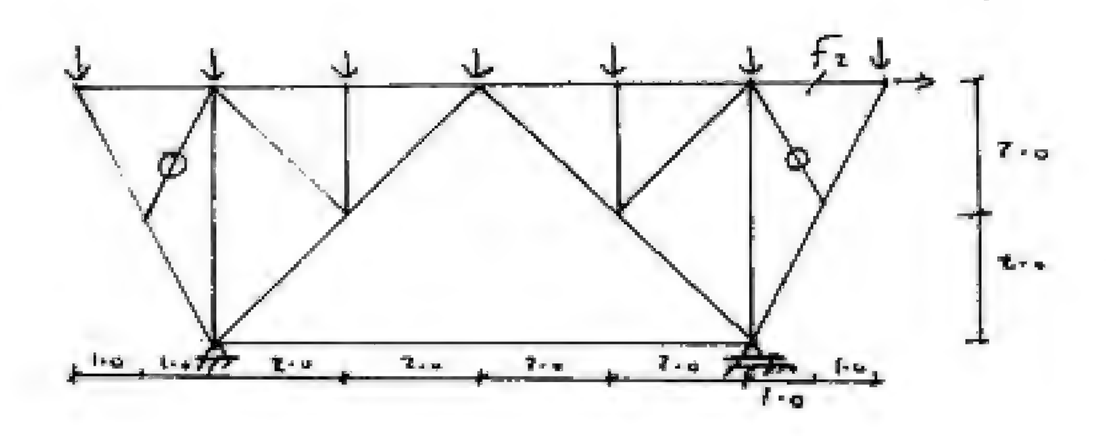
* $\Sigma M_a = 0.0$

$$-y_b * 8 - 2*2 + 3*2 + 3*4 + 3*6 + 3*8 + 2*10 + 4*4 = 0.0$$

$$y_b = 11.5 \text{ ton}.$$

* $\Sigma y = 0.0$

$$y_a = 7.5 \text{ ton}.$$



F_2 ↓2 → 4, θ, F'

$\Theta = \tan^{-1}\left(\frac{4}{2}\right)$

$= 63.43$

$\sin\Theta = 0.894$

$\cos\Theta = 0.447$

$\Rightarrow \Sigma y = 0.0$

$F' * \sin\Theta = 2$

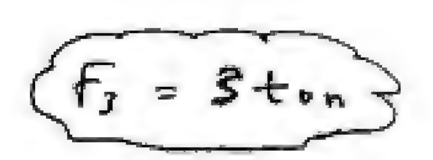
$\Rightarrow F' = 2/0.894$

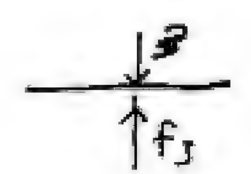
$= 2.237$ ton.

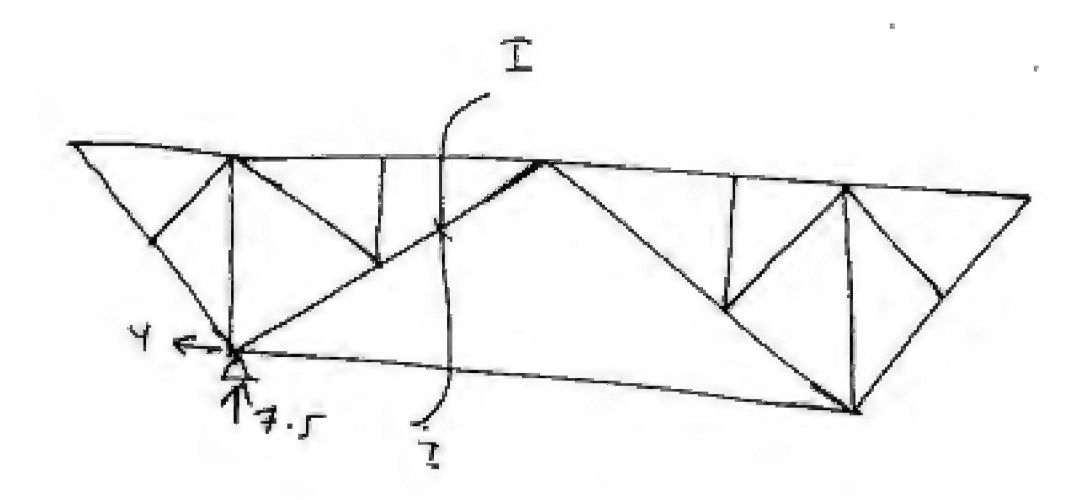
$\rightarrow \Sigma X = 0.0$

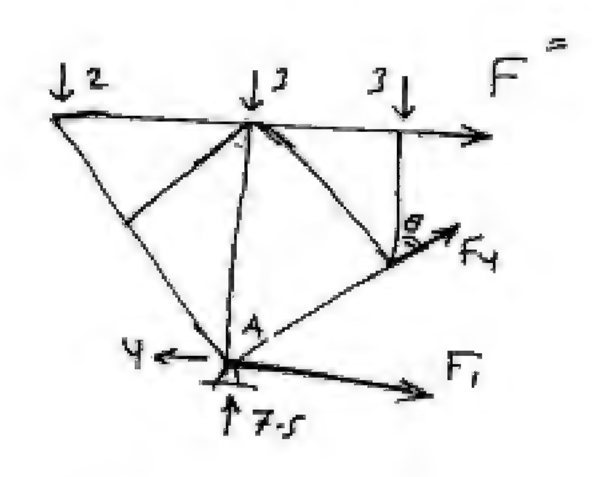
$4 + 2.237 * 0.447 = F_2$

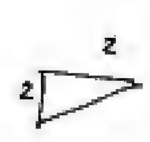
$\Rightarrow$ **$F_2 = 5$ ton**











$\theta = 45$

$\Sigma Y = 0.0$

$$2 + 3 + 3 = 7.5 + F_4 \cos\theta$$

$$\Rightarrow F_4 = 0.707 \text{ ton.}$$

$\Sigma M_A = 0.0$

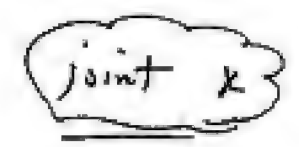
$$3 * 2 + F^{=} * Y = 2 * 2$$

$$\Rightarrow F^{=} = -0.5 \text{ ton}$$

$\Sigma X = 0.0$

$$4 + 0.5 = F_1 + 0.707\,(\sin 45)$$

$$F_1 = 4 \text{ ton}$$



$\downarrow 2t$, θ, F_k

$\Sigma y = 0.0$

$$2 = F_k \sin\theta \qquad \theta = 63^\circ$$

$$\Rightarrow F_k = 2.237$$

joint A

2.237, F_5, F_6, 4, 4, 7.5, θ_1, θ_2

$\theta_1 = 63^\circ$

$\theta_2 = 45$

$\Sigma X = 0.0$

$$4 - 2.237\cos\theta_1 - 4 + F_6\cos\theta_2 = 0.0$$

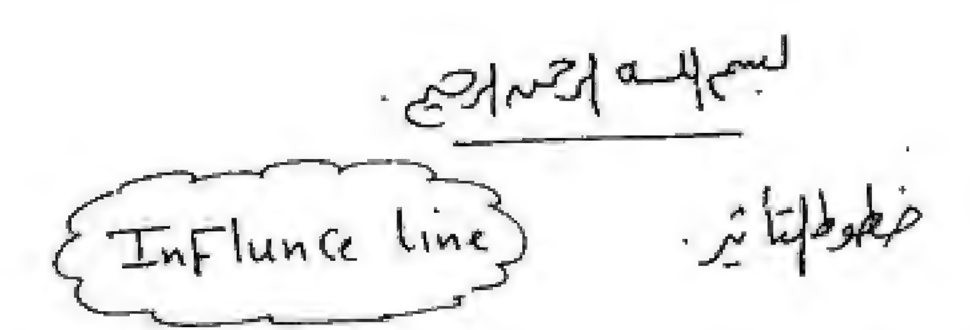
$$\Rightarrow F_6 = 1.141$$

$\Sigma y = 0.0$

$$2.237\sin 63 + F_5 + 1.141\sin 45 = 7.5$$

$$\Rightarrow F_5 = 4.5 \text{ ton}$$





* هي دراسة تأثير حمل (1t) بمروره على كمره لا يوجد عليها أحمال على شكل العزوم والقوى للوصول إلى أقصى قيمة يمكن تحقيقها لهذا الحمل.

"For Beams"

1t

Exampl ①

For the following beam draw $IL\,Y_A$, $IL\,Y_B$, $IL\,Q_C$, $IL\,M_C$

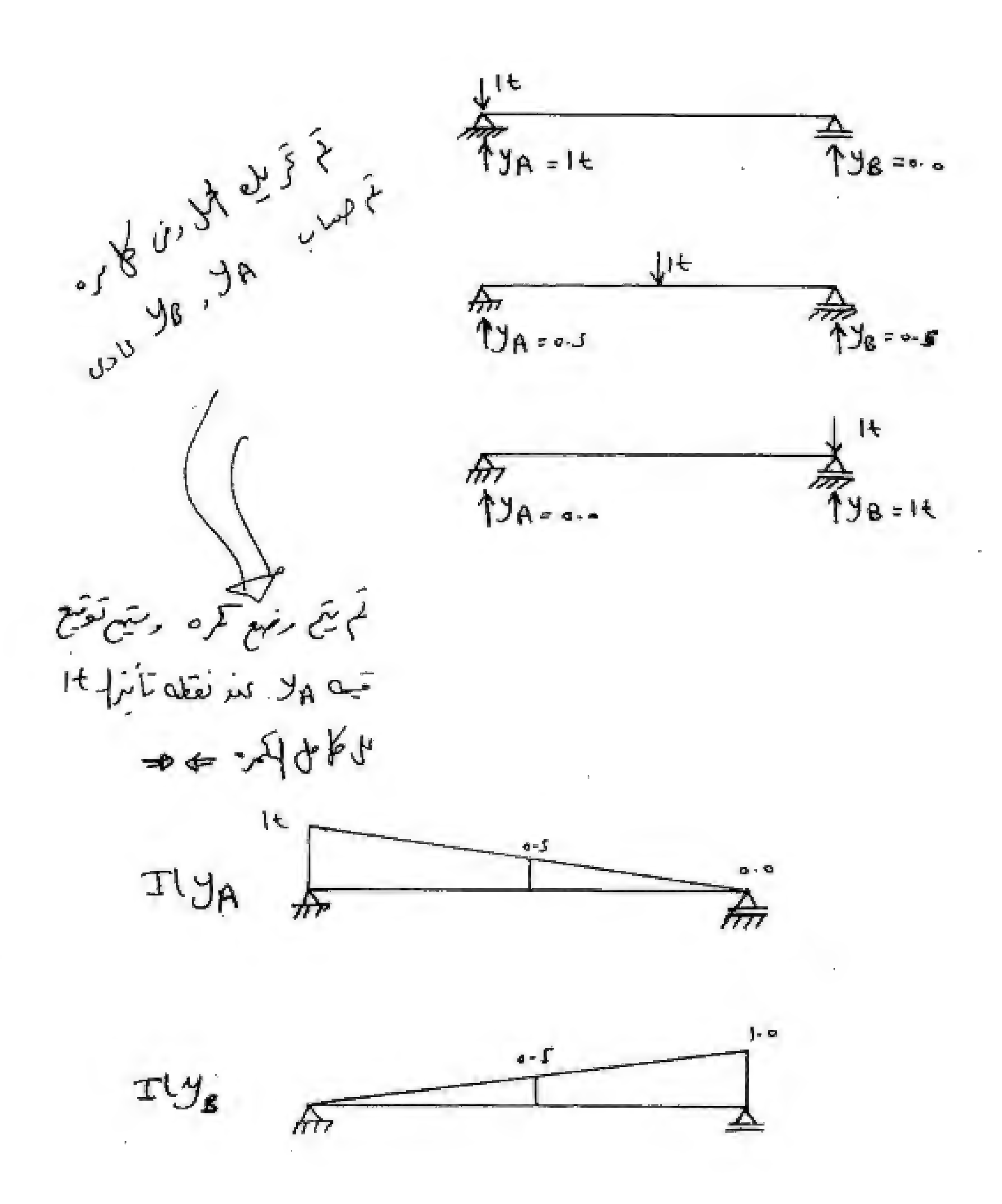
a ——— c ——— b

2.0m   2.0m

— Sol —

$IL\,Y_A$

معنى رسم خط تأثير Y_A يعني انه نضع الحمل على بداية الكمره ونحساب قيمة (Y_A) ← ثم تحريك الحمل باتجاه b ← وكل مره يتم حساب قيمة (Y_A) ونرسم هذه القيم.


1t
yA = 1t
yB = 0.0
1t
yA = 0.5
yB = 0.5
1t
yA = 0.0
yB = 1t
ILyA
1t
0.5
0.0
ILyB
0.5
1.0

ILQ

From A → C

كدا ما يتحرك الحمل من A ← C

كنحساب الـ shear عند (C)

نفعل أخذها من اليمين y_B ↑ الطالع

يبقى نازل

يعني نرسم $IL\ y_B$ مقلوب ناخذ

منه الجزء اللي يتحرك عليه الحمل المنقط

من A ← C

A — 1t — C — B, y_A, y_B

0.5 — 1t

From C → B

كدا ما يتحرك الحمل من C → B يبقى

حساب الـ shear من الشمال

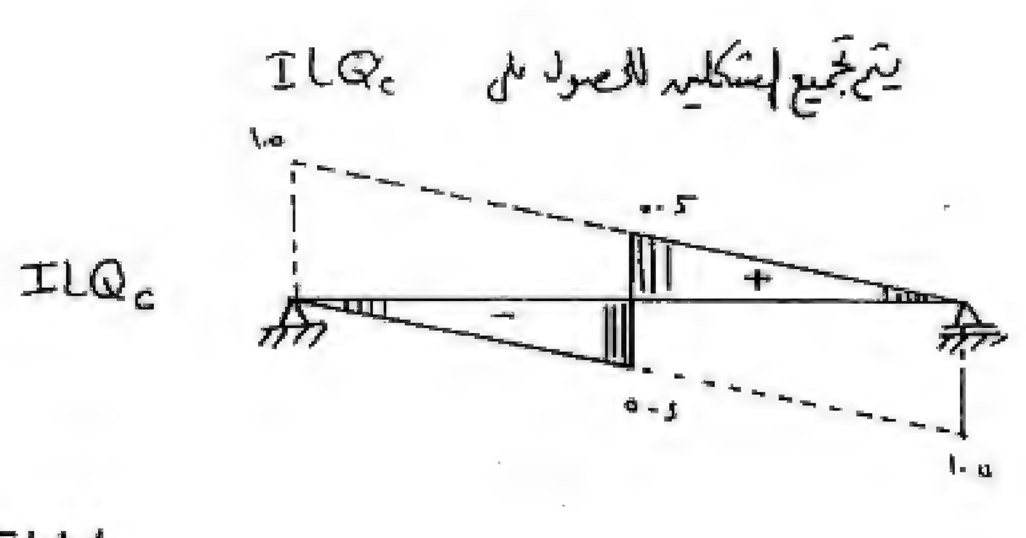
أسهل للحصول على Q_C

مقداره y_A ↑ الطالع

A — C — 1t — B, y_A, y_B

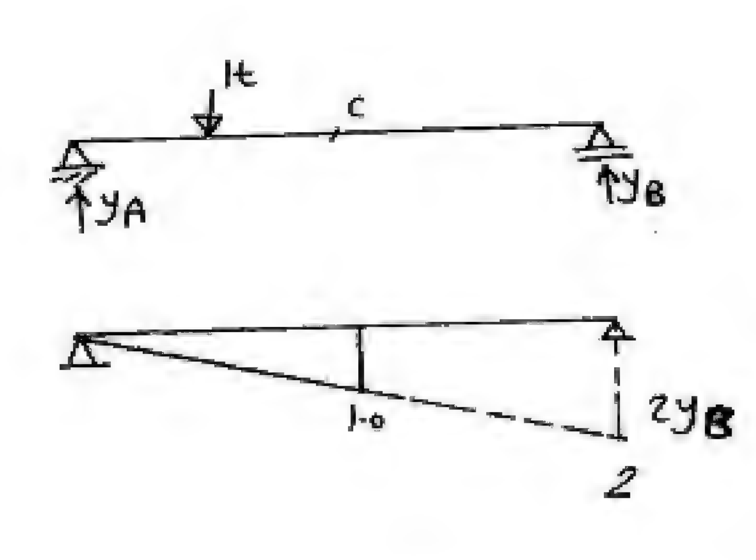
1.0 — 0.5

ILQ_c يتم تجميع الشكلين للحصول على



ILM_c

From A → C



عندما يتحرك الحمل من A → C نبدأ نحسب العزم عند C ⇐

$M_c = 2 y_B$ ↻

دي العزم كده.

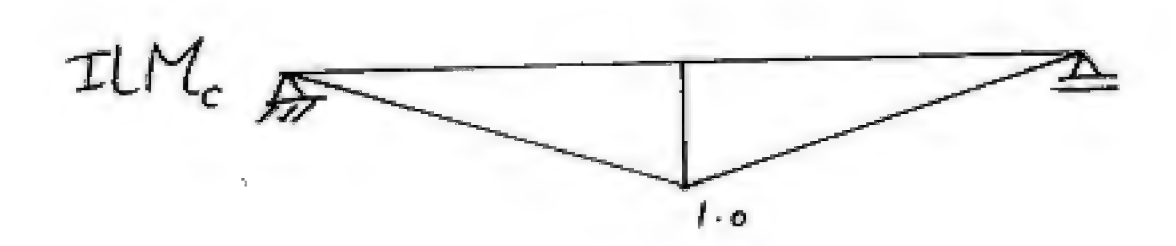
From C → B



عندما يتحرك الحمل من C → B

$M_c = 2 y_A$ ↺

تجميع إشكالية



كان يمكن رسمه مباشرة بوضع قيمة $\frac{Pab}{L}$

Example ②

A ——— S ——— B ——— n

4.0 m, 1.0

draw IL Y_A, Y_B, ILQ_S, ILM_S

ILM_B, IL Q_{BR}, ILQ_{BL}

— Sol —

ILY_A

From A ⟶ B كالسابقة

1 (load at end of overhang); reactions: ↓ 0.25 (at A), ↑ 1.25 (at B)

عند وضع ال 1t في نهاية الكابولي تكون قيمة ال Reaction $Y_A = -0.25t$

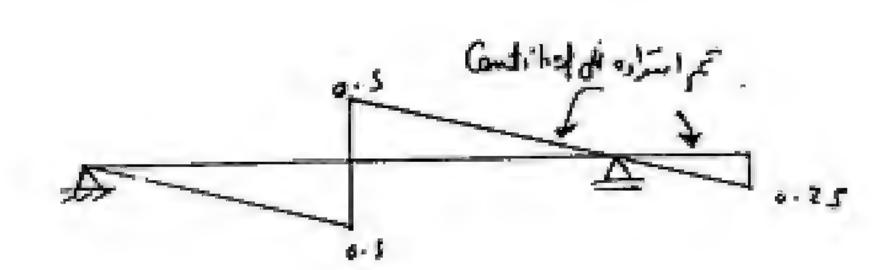
ILY_A: 1.0 (+) at A, (−) 0.25 at n

IL.Y_B: 1.0 at B, 1.25 at n

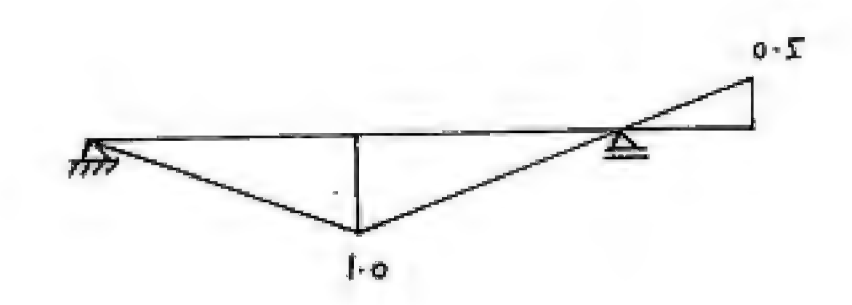
$Y_B = 1.25$

عند وضع ال 1t هنا .

IL Q_s



IL M_s



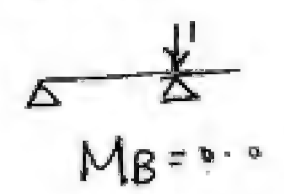
IL M_B

* كلما يتحرك الحمل من A → B كبر طالما لم يخرج الحمل على الـ Cantilever

∴ $M_B = 0.0$

* كلما يتحرك الحمل من B → n على الـ Cantilever يظهر العزم على M_B

$M_B = -1.0$



$IL M_B$



معنى هذا الشكل انه لما كنا نتحرك من A→B تكون قيمة العزم $M_B = 0.0$

ولما نتحرك من B→n تكون قيمة M_B متغيرة من 0.0 ← 1.0

$IL Q_{B_R}$

B_R

أي انه يريد الـ shear للـ Cantilivar

كنا نتحرك الحمل بين الـ supports ← لا يؤثر على الـ Cantilivar

لما نتحرك الحمل على الـ Cantilivar ← 1t

$Q_{Br} = +1$

$IL Q_{Br}$

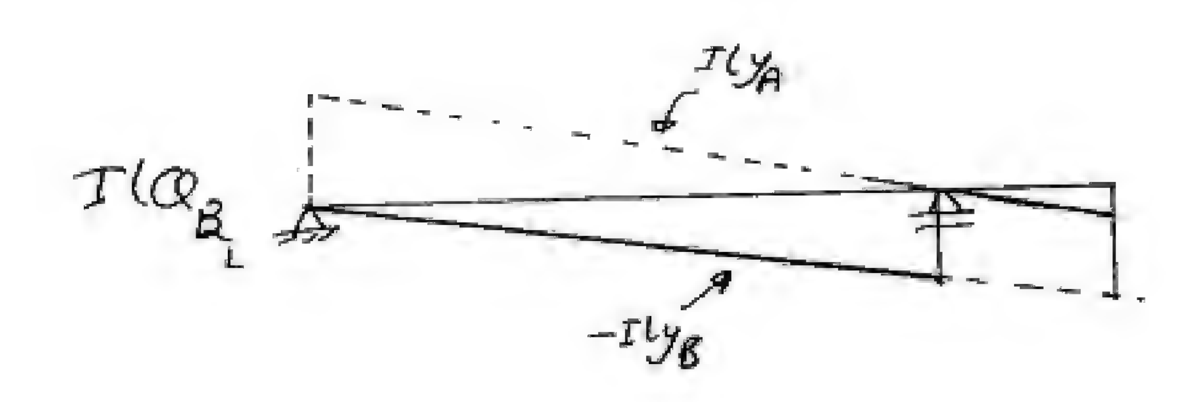
+1

$IL\ Q_{B_L}$

B_L

نقطة B_L هي قبل نقطة B

لكنه مرحلة بنا فوق الـ Support B



Example ③

$1t$ (load), n, A (fixed support) — $2.0\,m$

draw
$IL\,Y_A$, Q_A, M_A
Q_n, M_n

— Sol —

$IL\,Y_A$

$1t$ ↓ — Y_A ↑

دايماً قيمة $(1t = Y_A)$ على طول

$IL\,Y_A$: $+1.0$

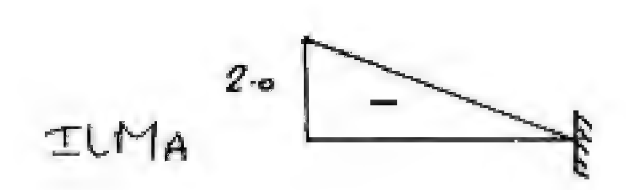
$IL\,Q_A$

$1t$ ↓

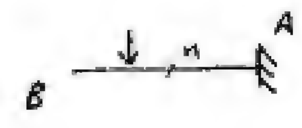
دايما ستكون 1t لأسفل عشان نازل

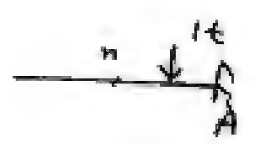
$IL\,Q_A$: -1.0

ILMA



ILQn





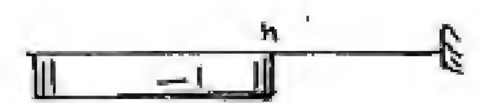
B → n

$Q_n = -1$

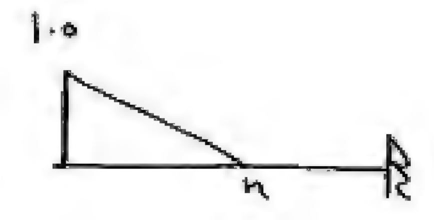
n → A

$Q_n = 0.0$

ILQn

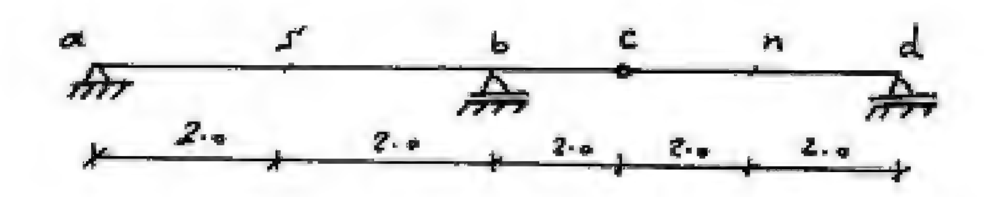


ILMn



Example (4)

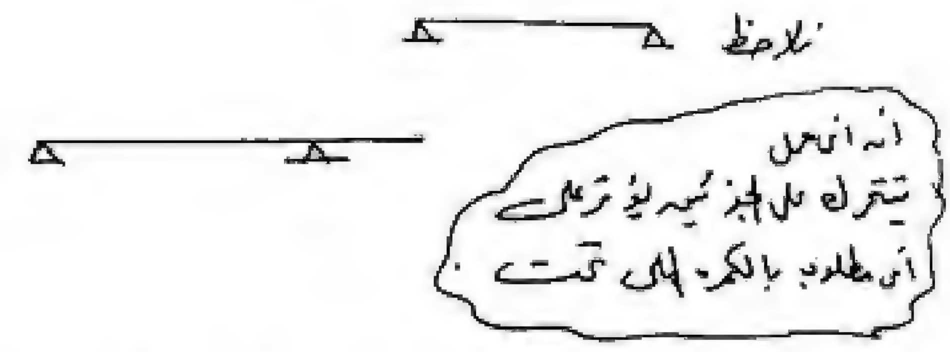
حالة الكمرات اللي بها Intermed ← نرى أن الجزء اللي يتحرك بالحمل فيؤثر على المطلوب في المسألة .



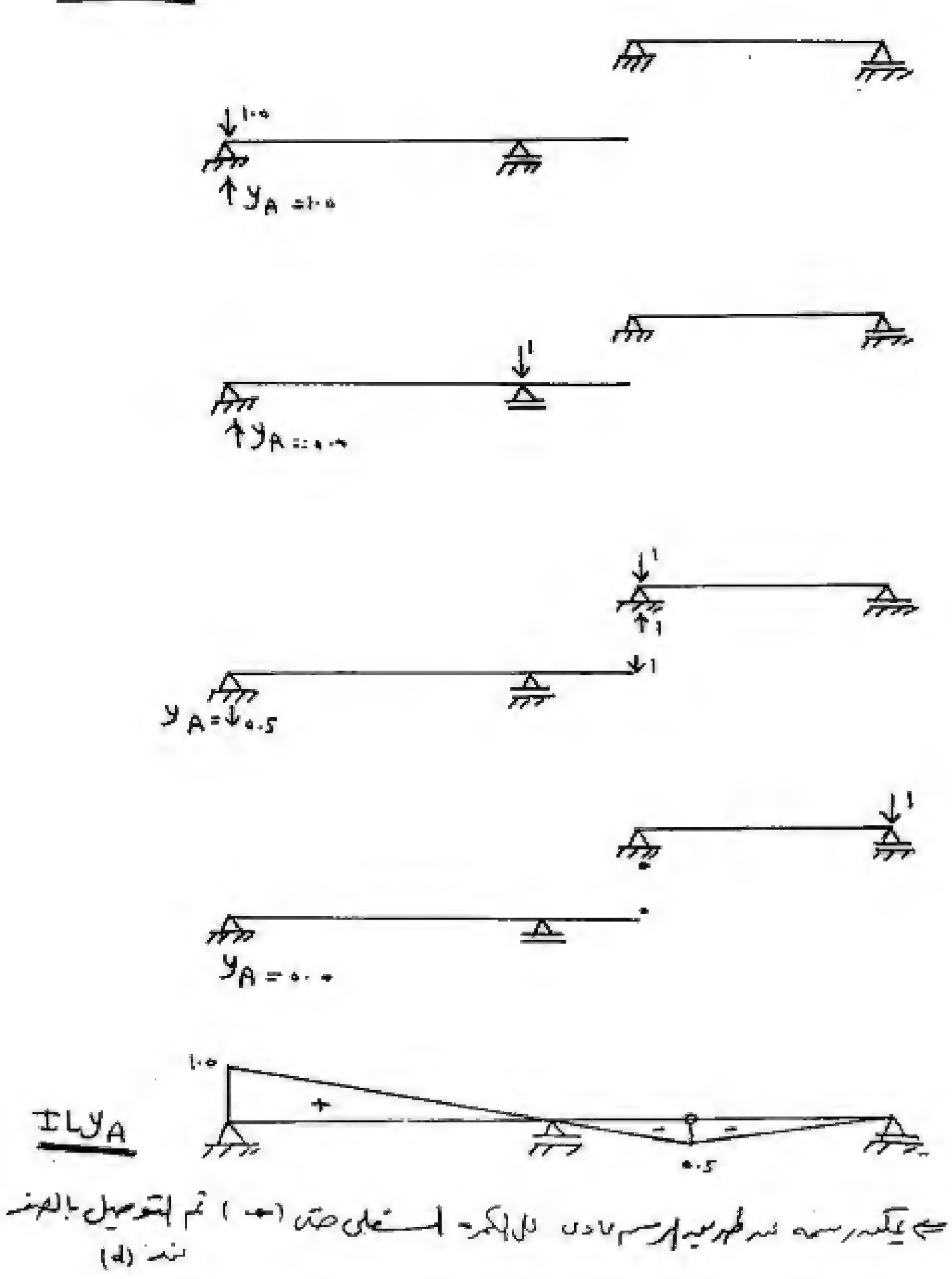
Req IL Y_a , Q_s , M_s , Q_{bR} , Q_{bL}

Q_n , M_n , Y_d , M_b

— Sol —

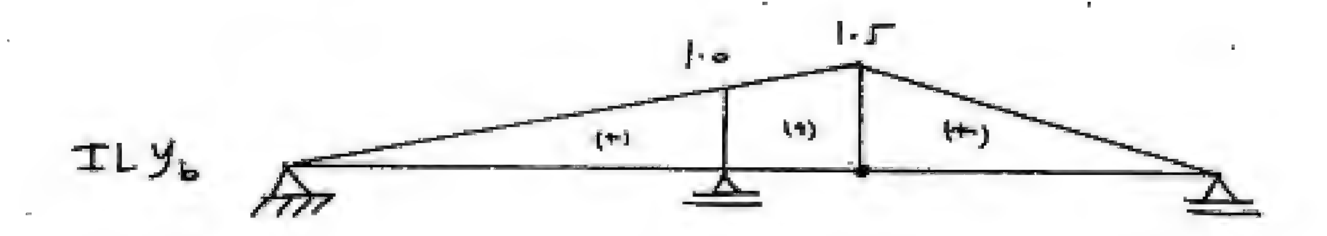


* ولكن عند أن مطلوب في الكمرة العلوية (Y أو Q أو M) عندما يكون الحمل على الكمرة السفلي لا يؤثر فلا يرسم شيء .

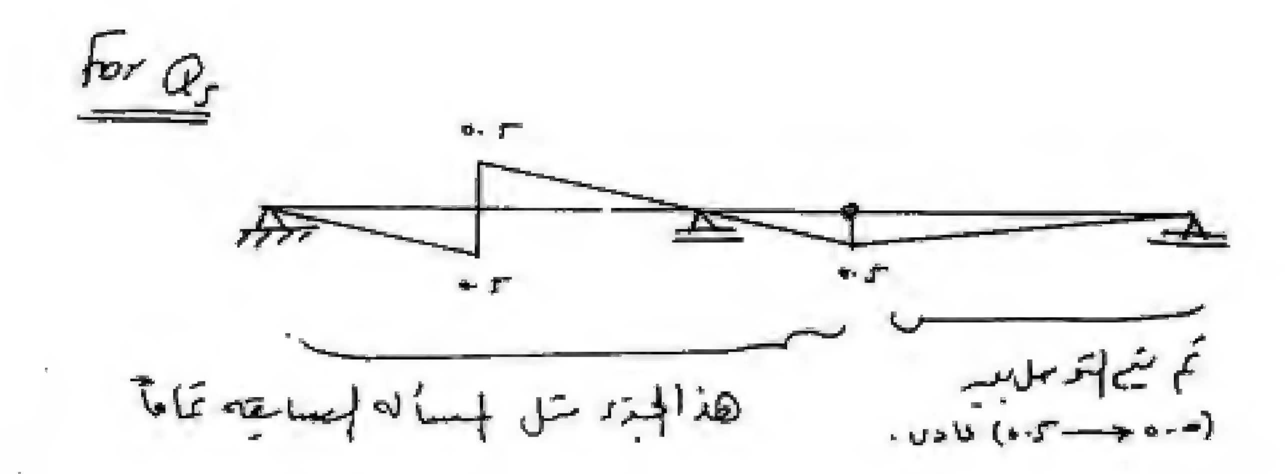


For y_A
$y_A = 1.0$
$y_A = 0.0$
$y_A = \downarrow 0.5$
$y_A = 0.0$
1.0
+
ILy$_A$
0.5
⇐ يمكن رسمه بطريقة رسم I.L للكمرة السفلى حتى (c) ثم التوصيل بالصفر
عند (d)

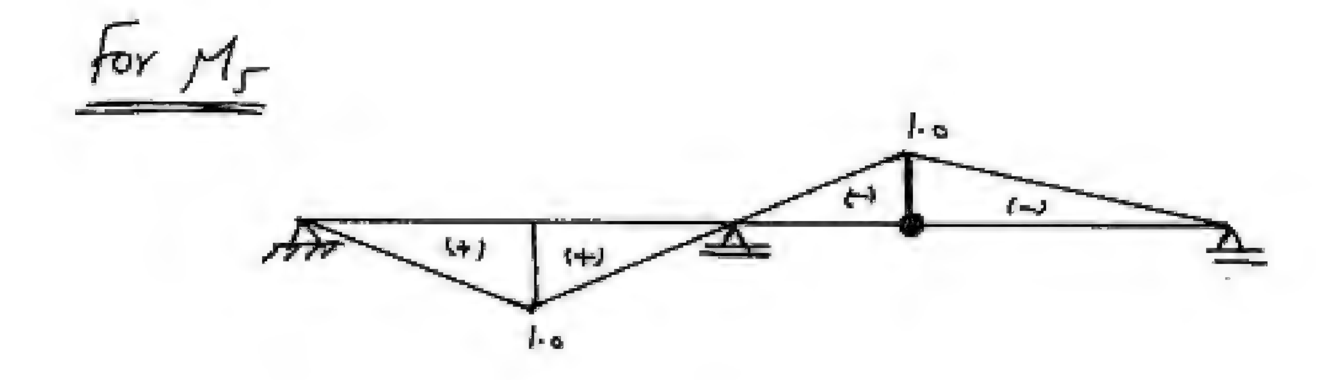
For ILy_b



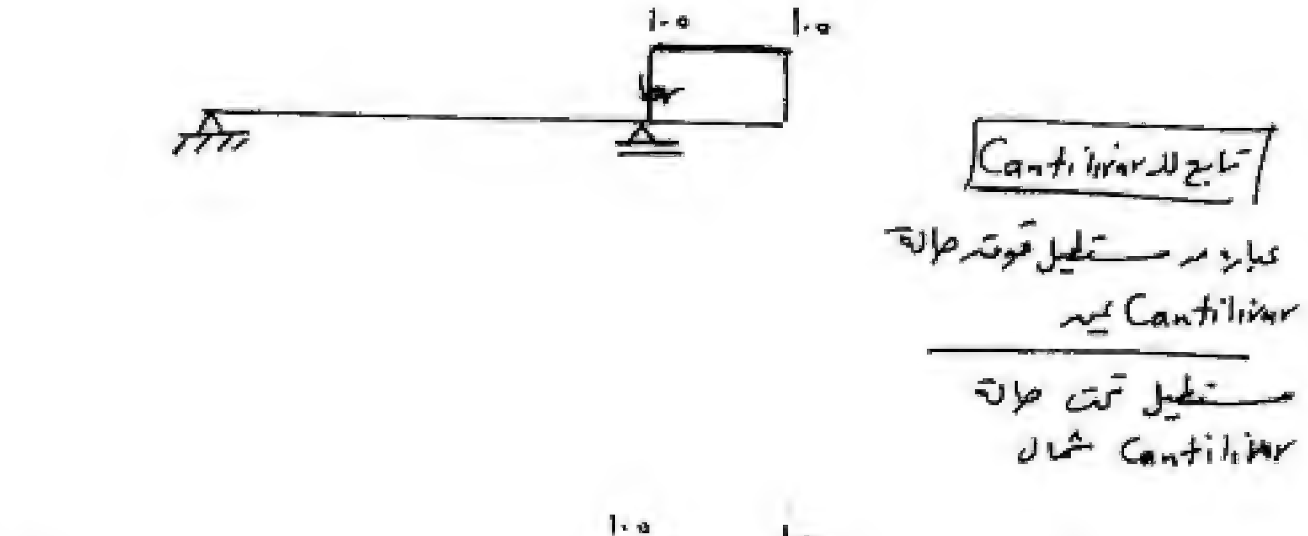
For Q_5



For M_5

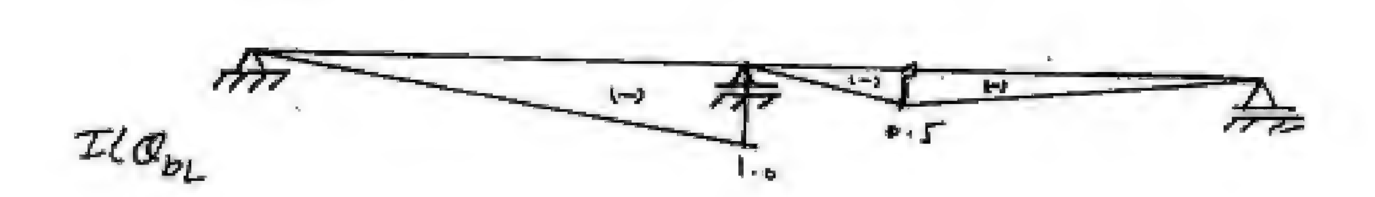


For IL Q_{br}

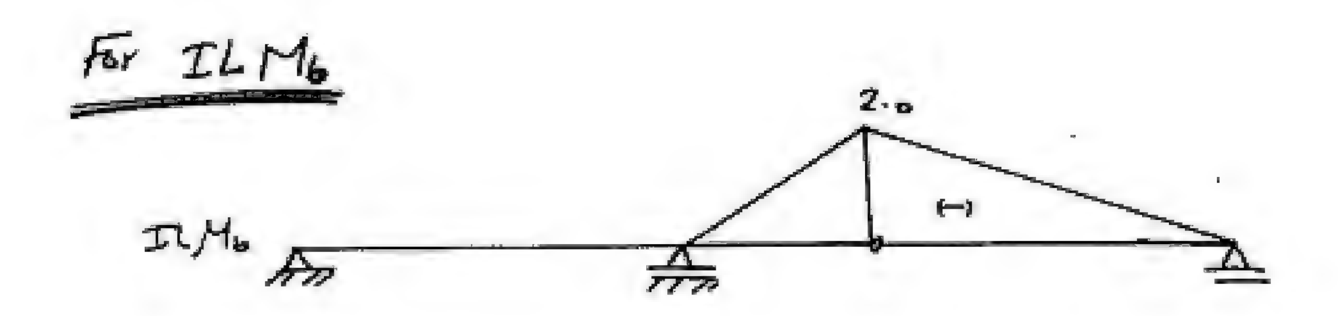


IL Q_{br}

For IL Q_{bL}

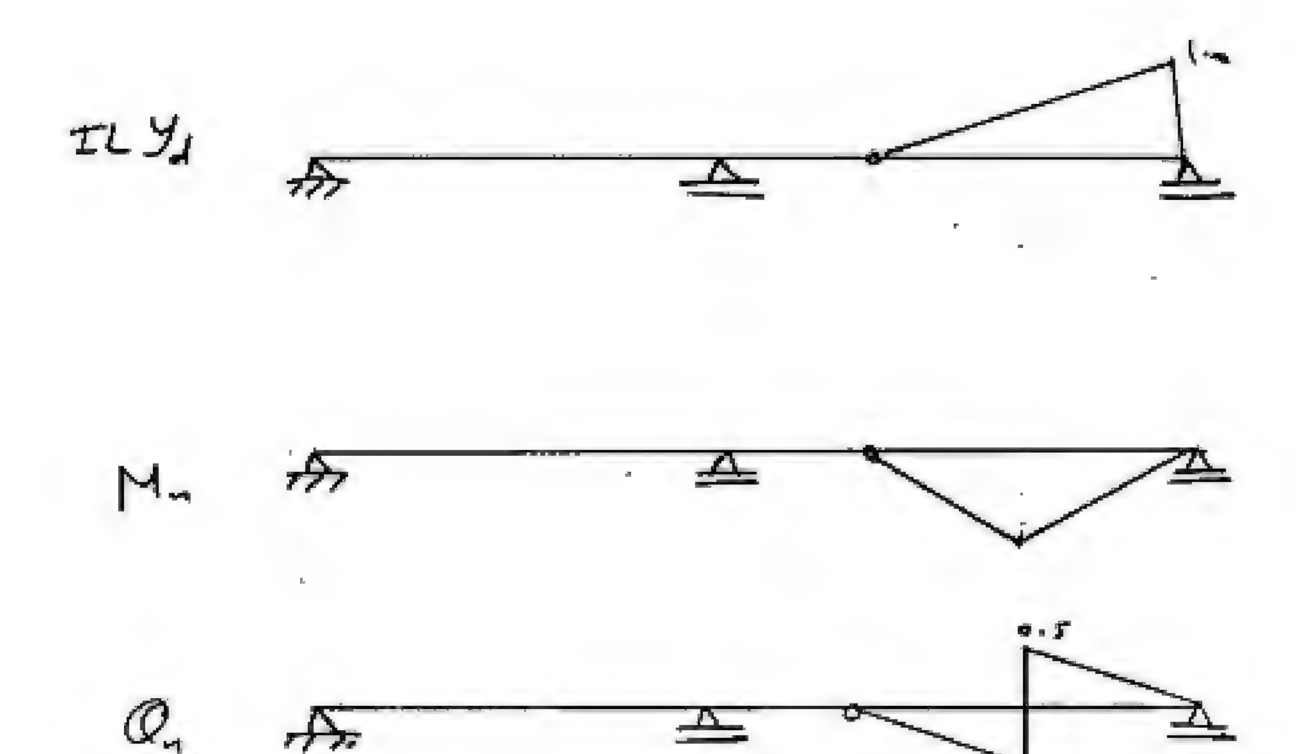


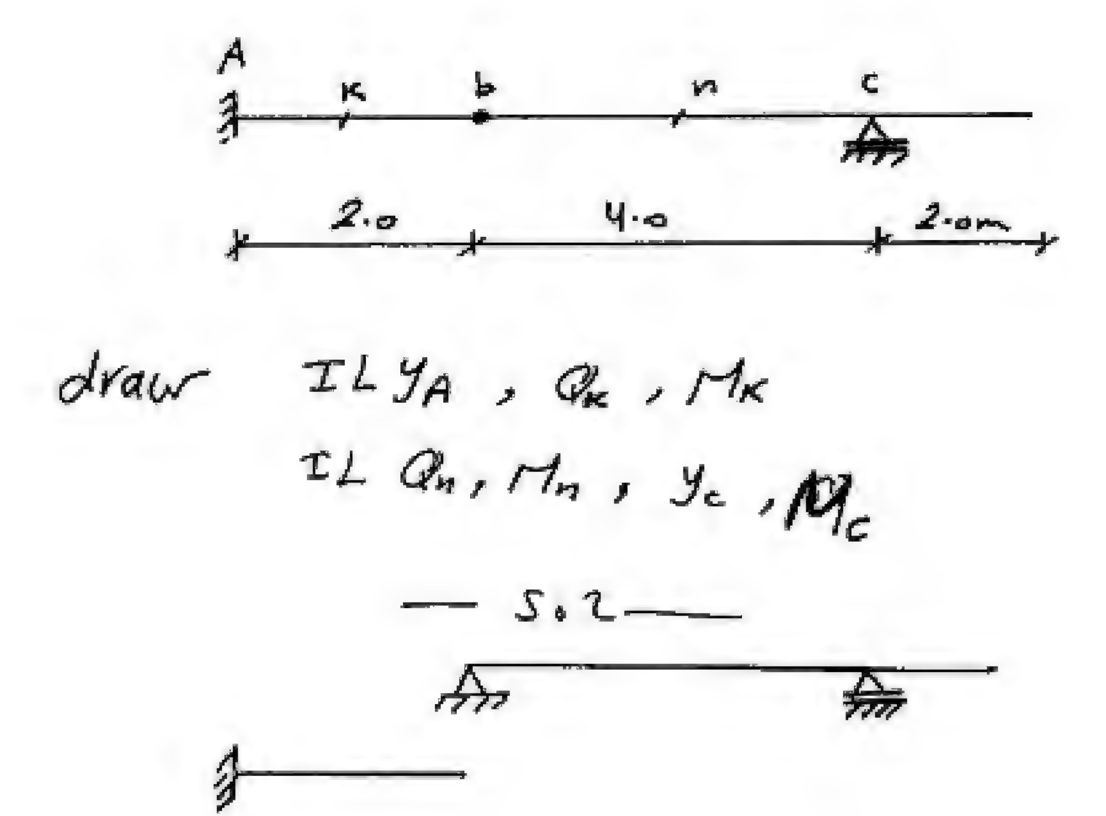
For IL M_b



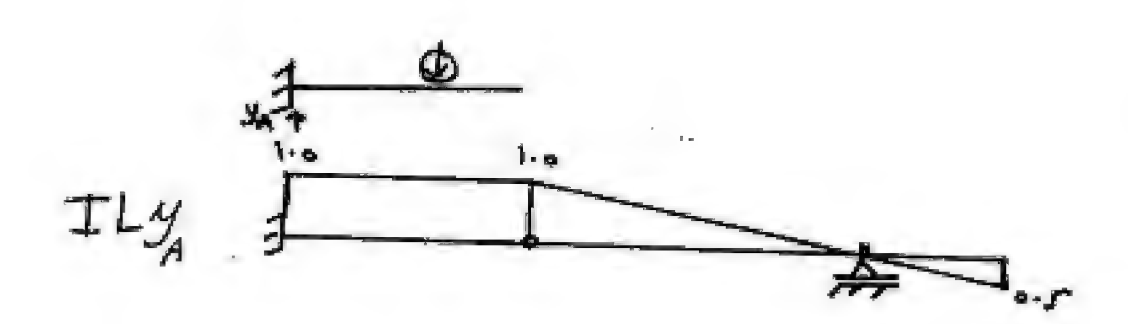
$IL(Q_n, M_n, y_d)$

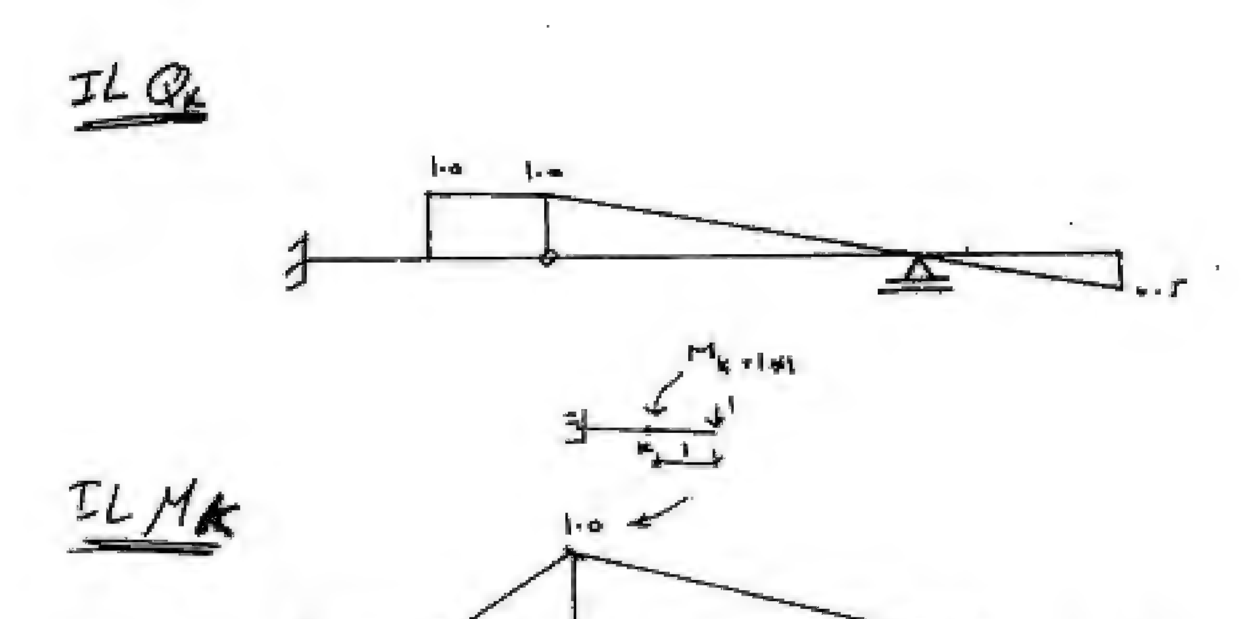
تابع للكمرة العلوية وبالتالي يتم رسمهم على طول مقطع والباقي (صفر)





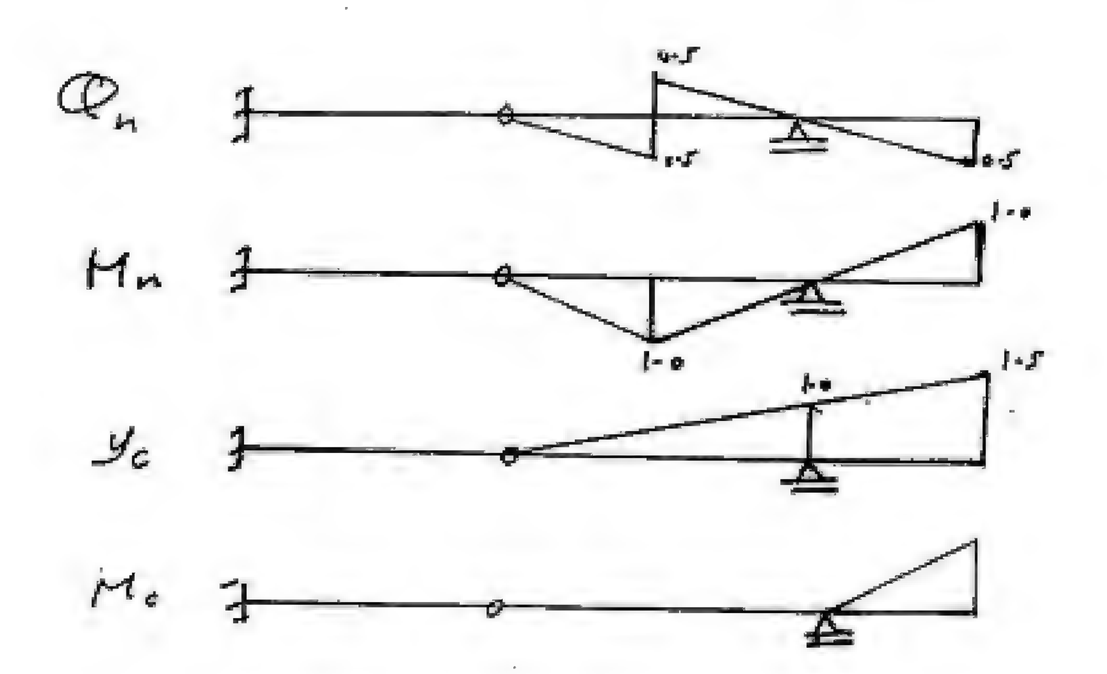
① ILy_A





$IL\ Q_n, M_n, y_c, M_c \longrightarrow$ تابع الجزء الأيسر

∴ نرسم الباقي فقط (على الجزء الأيسر فقط)



مطلوب آخر

$M_A \leftarrow max\ (B.M)$ + مطلوب

$max\ (Y_A)$

$max\ (Q_n)$

$2t/m = (Uniform$) ناتج عن حمل

III $\underline{M_A}$

2t/m

2.

$IL\ M_A$

يتم وضع الحمل على أحد المساحات اما العلوية أو السفلية ويتم ضرب الحمل * المساحة) حالة الحمل الموزع.

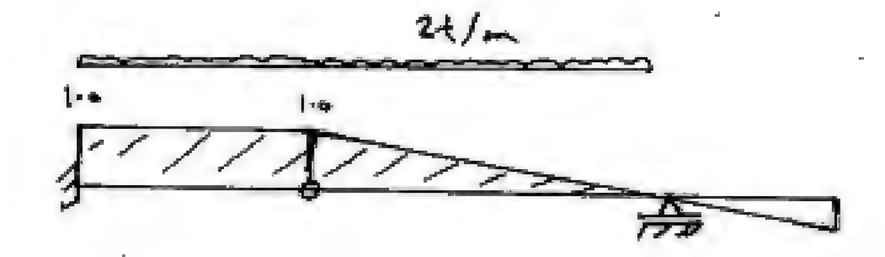
ولا يهم أن تكون الأكبر سالبة أو موجبة.

⇐ في هذا المثال المساحات الأكبر فوقية -

$$M_{A(max)} = (\tfrac{1}{2}*2*2 + \tfrac{1}{2}*4*2)*2t/m$$
$$= 12\ t.m.$$

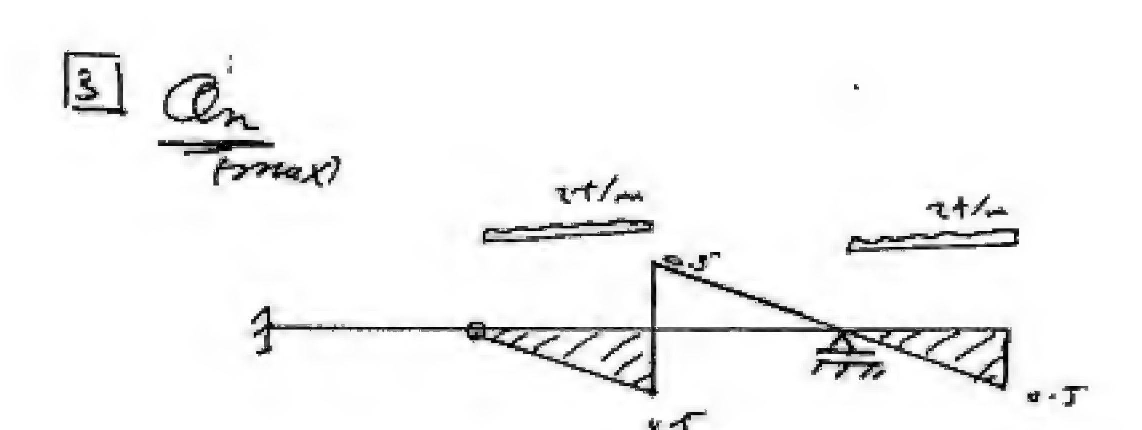
لا نضع أحمال على الجزء الأخير لأن مساحته بإشارة معاكسة للمساحة العلوية وبالتالي تقلل العزم.

2 $\underline{\underline{y_A}}$ (max)



$$y_{A_{max}} = 2 * [1 * 2 + \tfrac{1}{2} \times 1 * 4] = 8$$

3 $\underline{\underline{Q_n}}$ (max)



$$Area = \tfrac{1}{2}(0.5 * 2) + \tfrac{1}{2}(0.5 * 2)$$

$$= 1$$

$$\therefore Q_{n\,max} = 2 * 1 = 2 \text{ ton.}$$

H.W

1

Req

y_A , y_c , y_e

Q_g , Q_h , Q_i

M_g , M_h , M_i

M_b , Q_{bR} , Q_{eL}

2

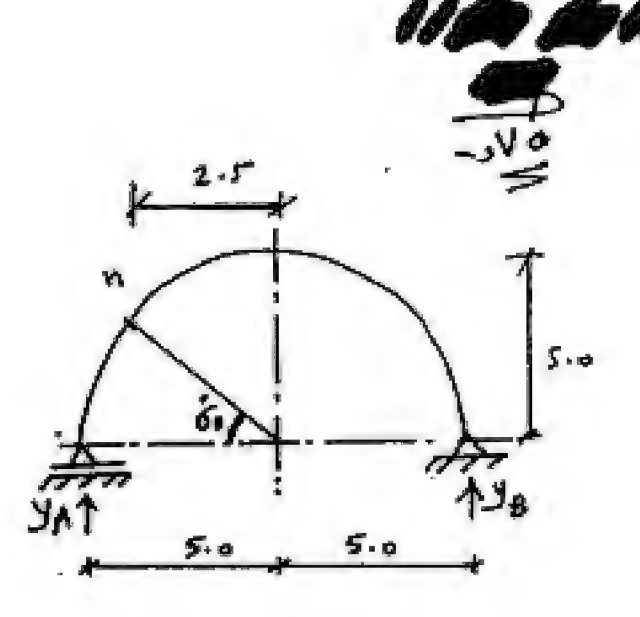
Req IL

y_A , y_c , y_e

Q_A , Q_{cR} , Q_{eR}

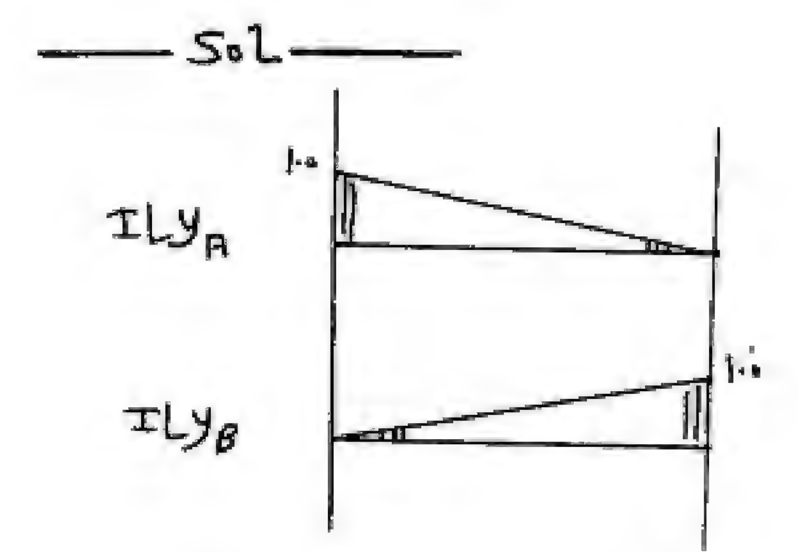
M_e

Arch



draw IL y_A, y_B, N_n, Q_n, M_n

— Sol —



(1t) From $A \rightarrow n$

نتعامل بالأيمن

$N_n = y_B \cos\theta = 0.5\, y_B$

$Q_n = -y_B \cdot \sin\theta = -0.86\, y_B$

$M_n = +7.5\, y_B$

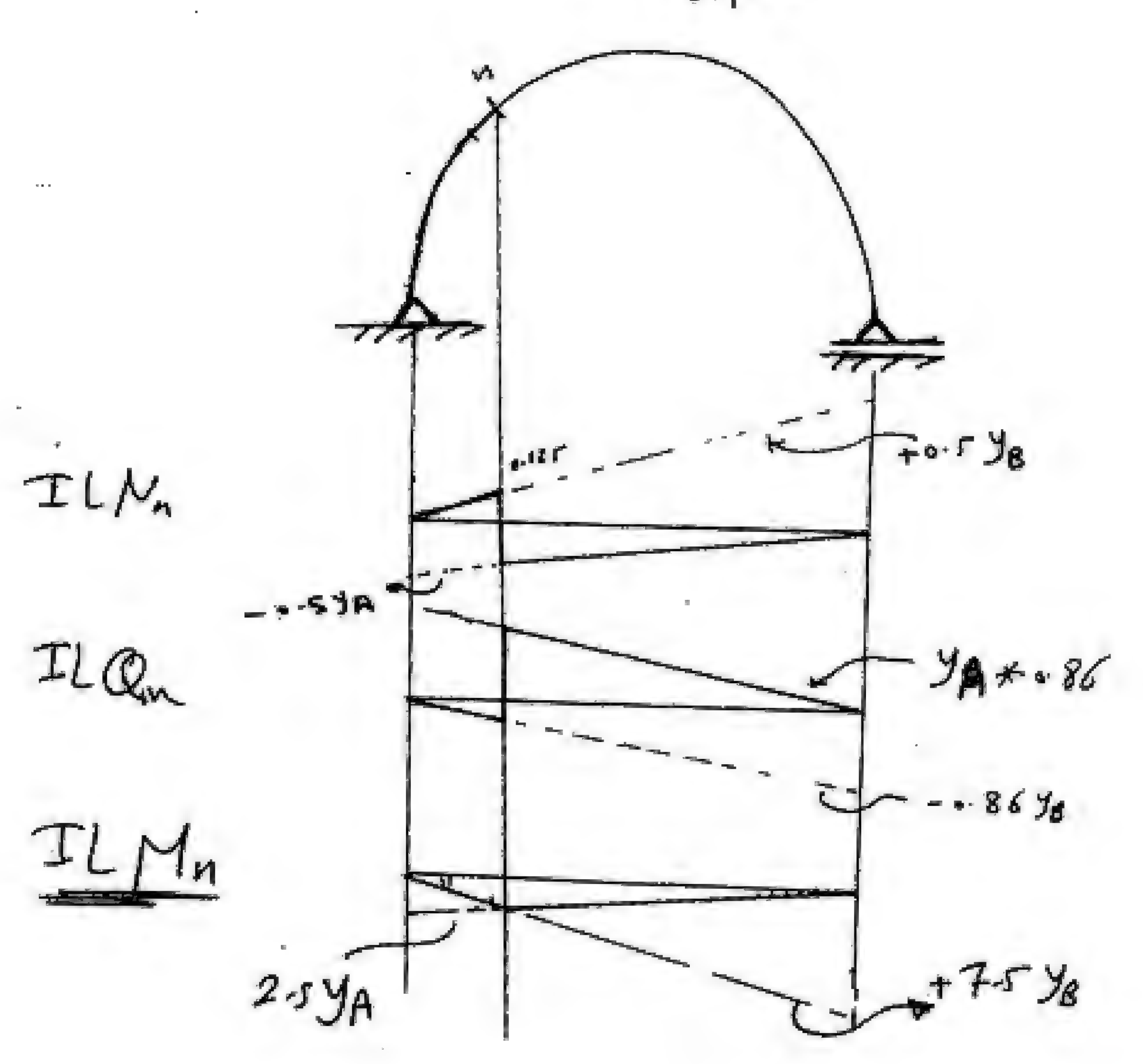
$\theta = 60$

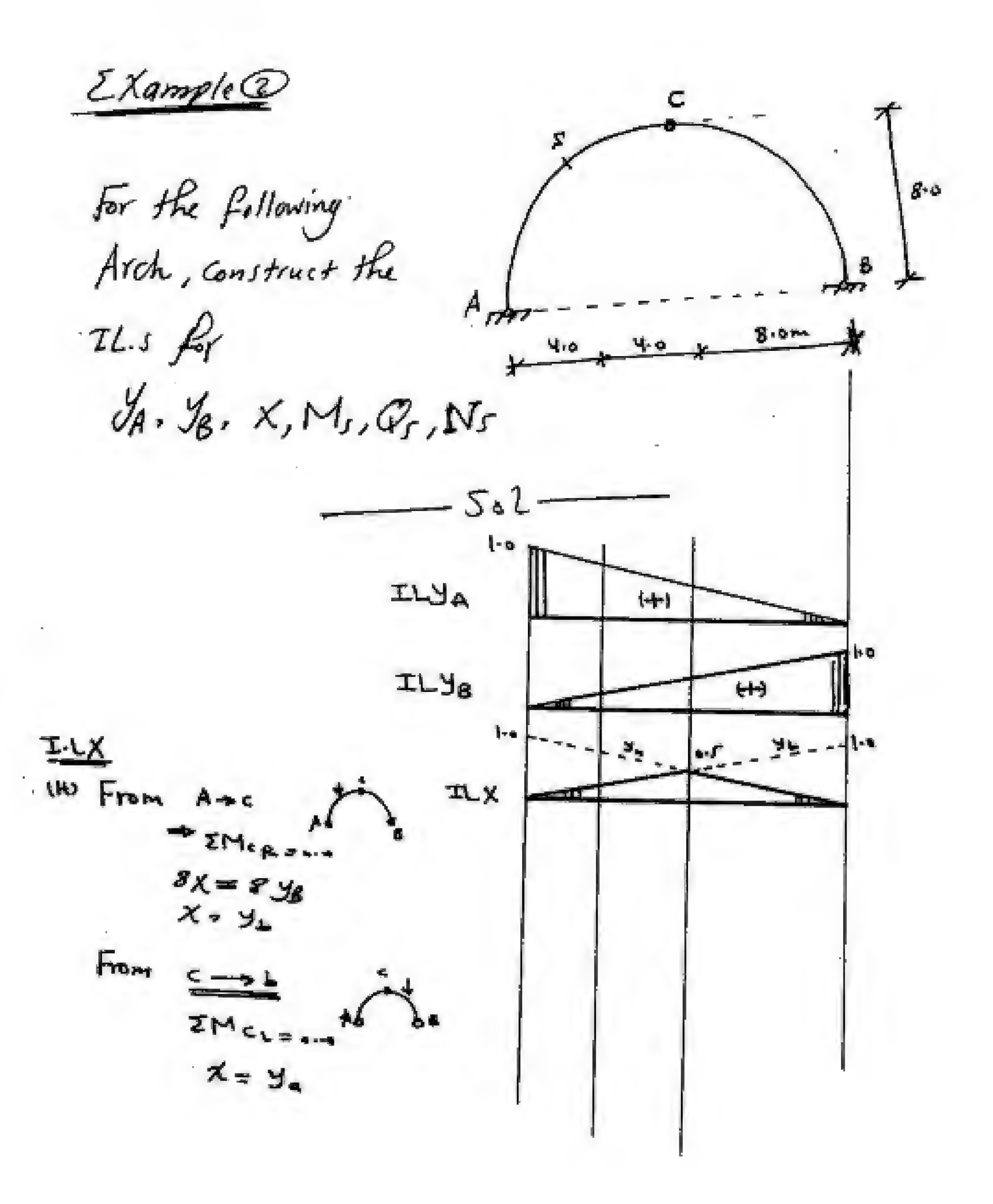
If move from n → B

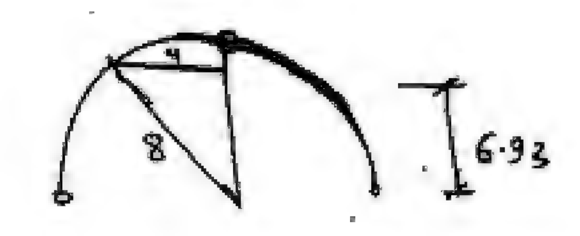
$N_n = -Y_A * 0.5$

$Q_n = +0.866\, Y_A$

$M_n = 2.5\, Y_A$




Example ②
For the following Arch, construct the IL.s for
yA, yB, X, Ms, Qs, Ns
C
S
A
B
8.0
4.0
4.0
8.0m
Sol
1.0
ILYA
(+)
ILYB
1.0
(+)
I.L.X
1.0
1.0
0.5
ILX
From A→C
ΣMcR = 0.0
8X = 8 yB
X = yB
From C→B
ΣMcL = 0.0
X = yA



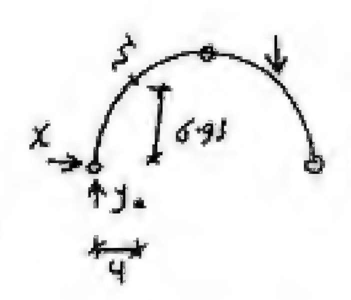
IL M_s

From $A \rightarrow s$

$$\therefore M_s = Y_b * 12 - X * 6.93$$

$$= 12\,Y_b - 6.93\,X$$

From $s \rightarrow B$



$$\therefore M_s = 4\,Y_a - 6.93\,X$$

$\theta = 30$

$\sin = 0.5$

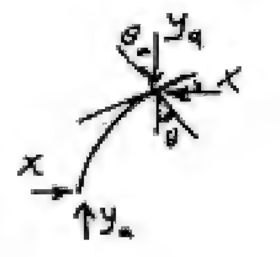
$\cos = 0.866$

IL Q_s

From $A \rightarrow s$

$$Q_s = -[0.5\,X + 0.866\,Y_b]$$

From $s \rightarrow B$



$$Q_s = [0.866\,Y_a - 0.5\,X]$$

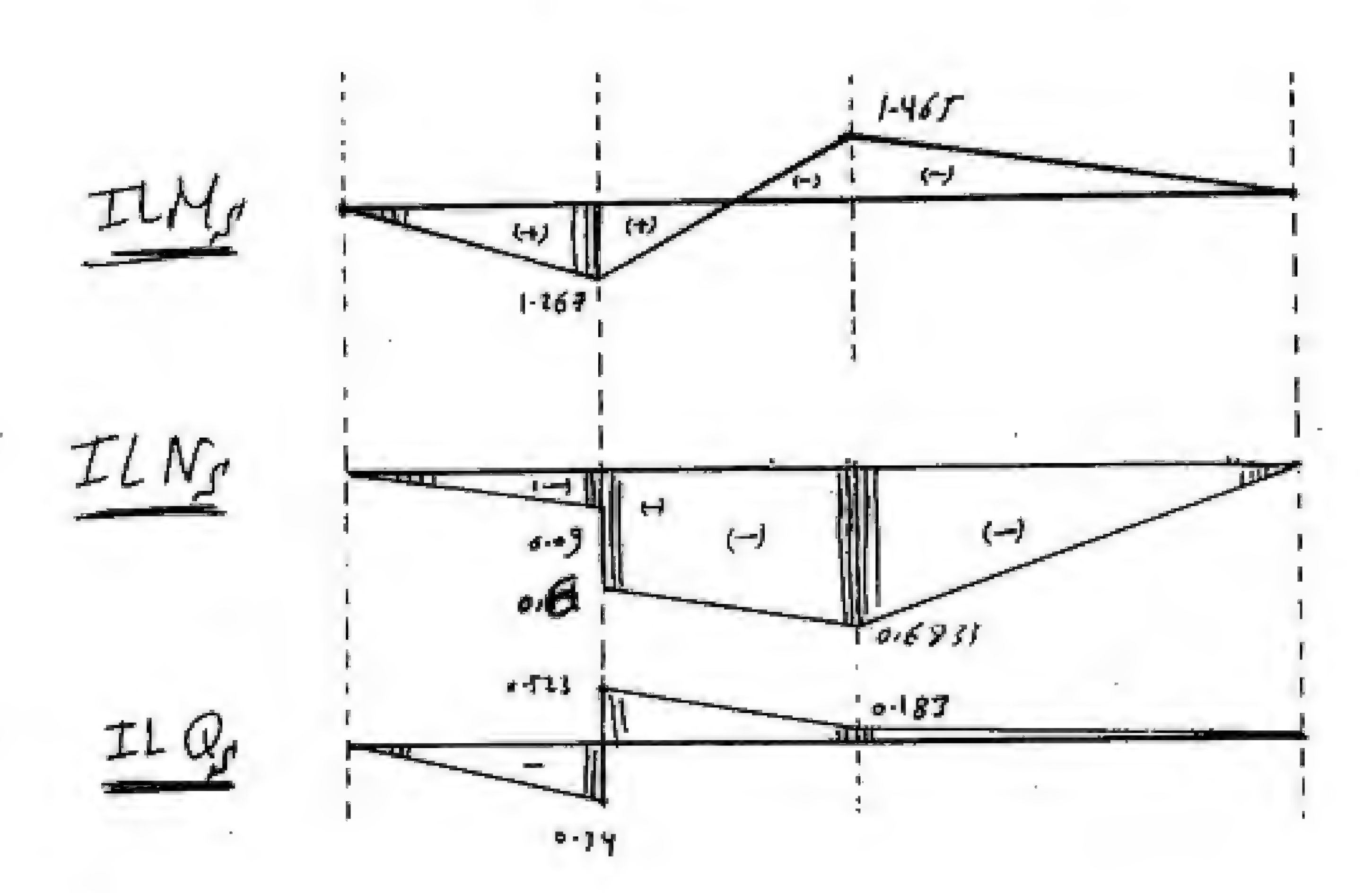
IL $N_{s'}$

From $A \rightarrow s$

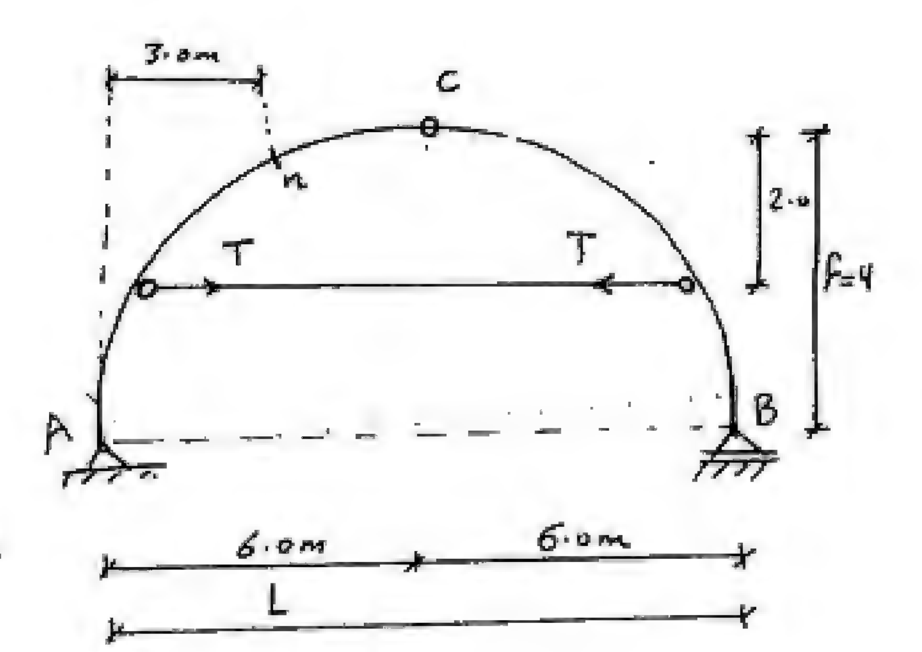
$$N_{s'} = \left[0.5\, y_b - 0.866\, x\right]$$

From $s' \rightarrow B$

$$N_{s'} = -\left[0.866\, x + 0.5\, y_a\right]$$



Example(3)



$$y = \frac{4f}{L^2}(L-X)X$$

Req:-

y_A, y_B, N_n, Q_n, M_n

— Sol —

$f = 4.0\,m$

$L = 12\,m$

$$\therefore\ y = \frac{4*4}{12^2}(12-X)X = \frac{X}{9}(12-X)$$

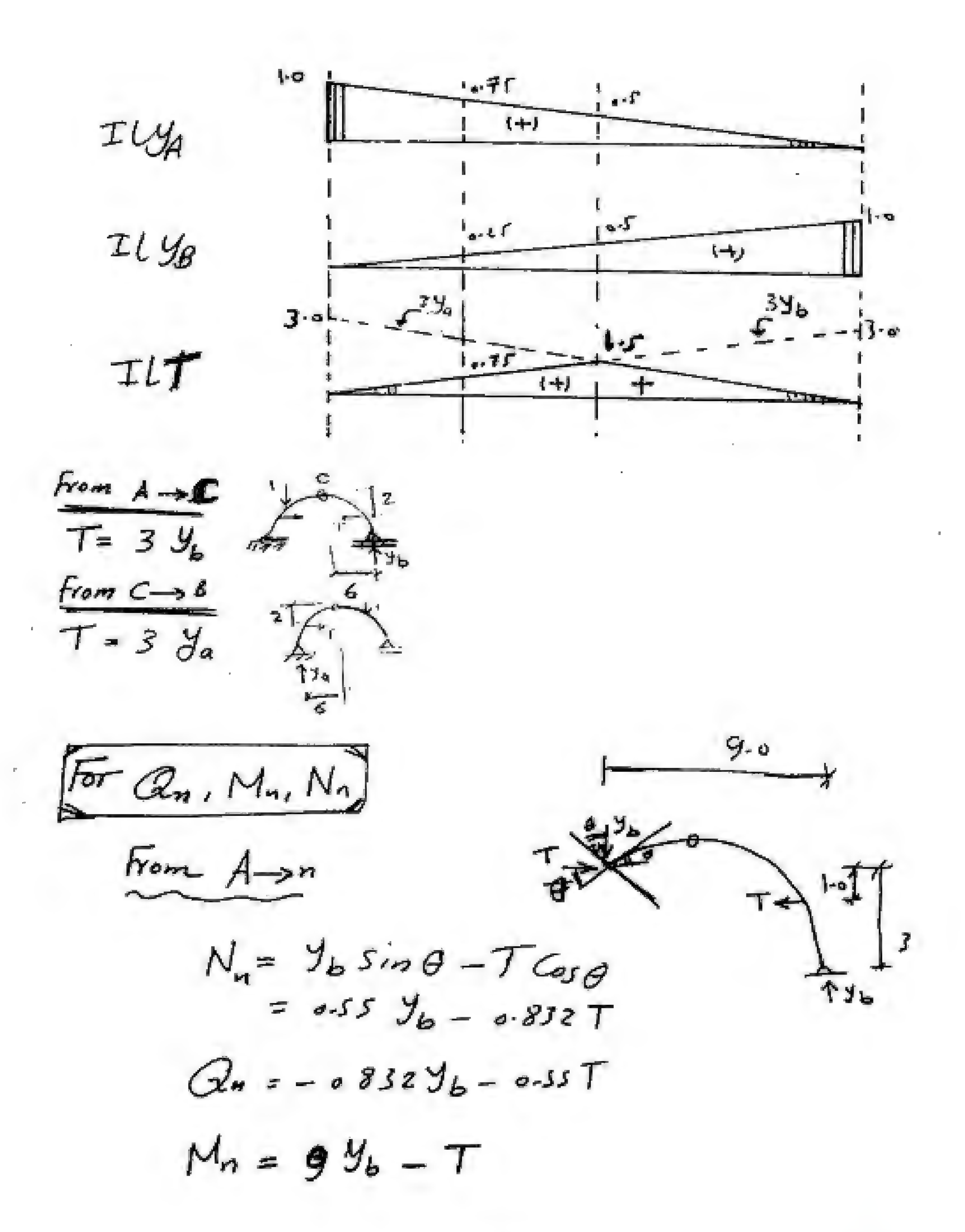
$\therefore$ at $X = 3.0 \longrightarrow (y = 3.0)$

$\longrightarrow \tan\theta = y' = \left(\frac{4}{3} - \frac{2X}{9}\right) = ✓$

$(\theta = 33.69°)$

$\sin\theta = 0.55$

$\cos\theta = 0.832$



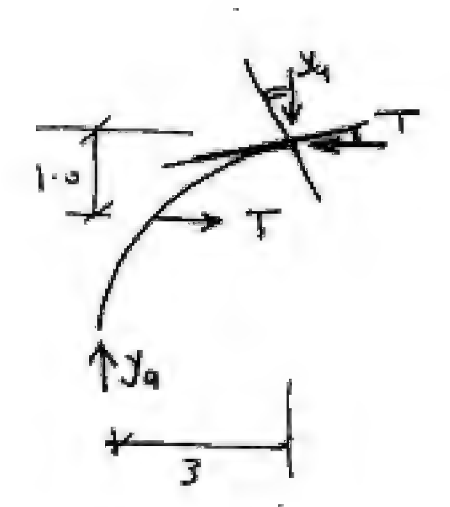
IL y_A
1.0
0.75
0.5
(+)
IL y_B
0.25
0.5
1.0
(+)
IL T
3.0
$3y_a$
$3y_b$
1.5
0.75
(+)
+
From A → C
T = 3 y_b
From C → B
T = 3 y_a
For Q_n, M_n, N_n
From A → n
9.0
1.0
3
T
θ
y_b
$N_n = y_b \sin\theta - T\cos\theta$
$= 0.55\, y_b - 0.832\, T$
$Q_n = -0.832\, y_b - 0.55\, T$
$M_n = 9\, y_b - T$



$$N_n = -0.832\,T - 0.55\,Y_a$$

$$Q_n = +0.832\,Y_a - 0.55\,T$$

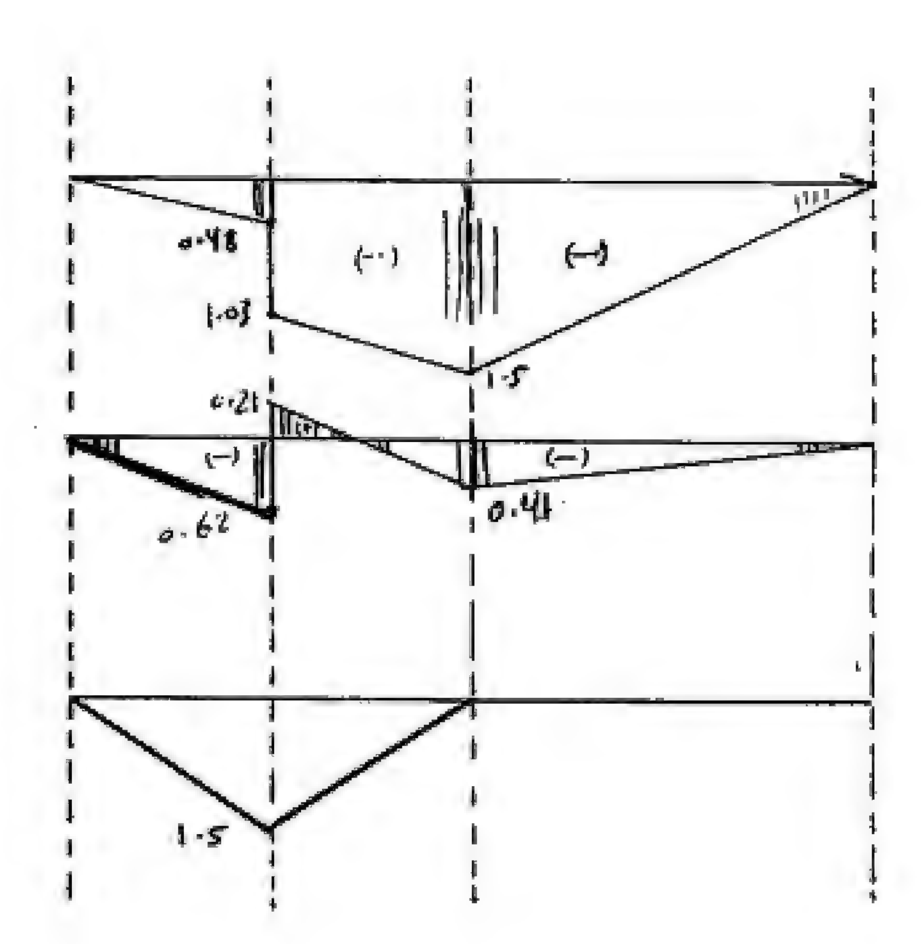
$$M_n = 3\,Y_a - T$$



IL N_n

IL Q_n

IL M_n



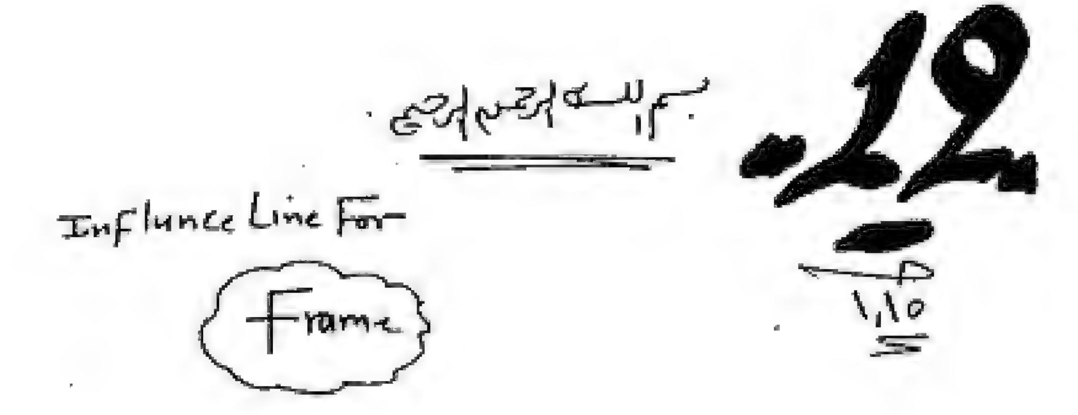
Final 2004

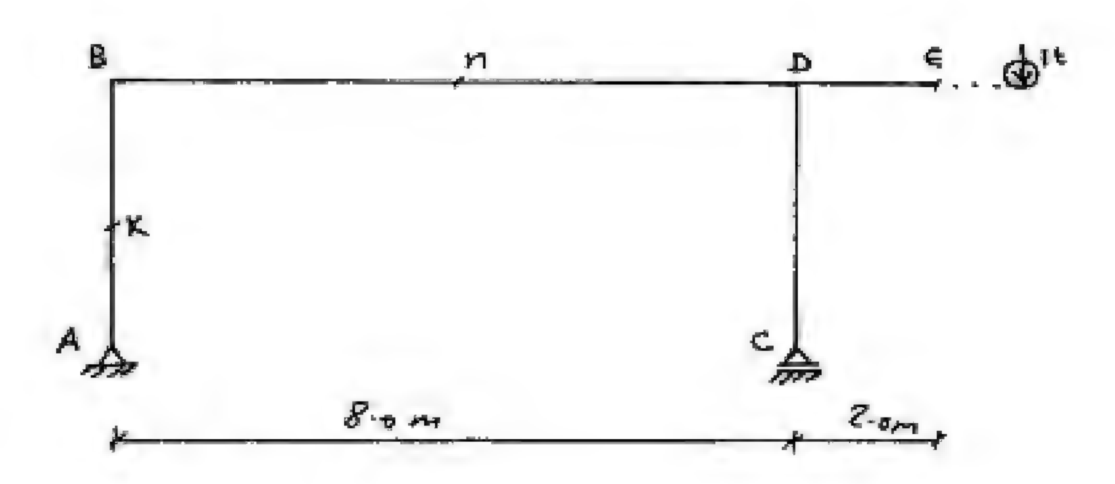
Req

IL y_A, y_B, x_B

M_S, N_S, Q_S

← Solve it





For the Following Frame

draw $IL\,Y_A$, $IL\,Y_c$

$IL\,Q_n$, $IL\,M_n$, $IL\,N_K$

$IL\,Q_{DR}$, $IL\,Q_{DL}$, $IL\,M_D$

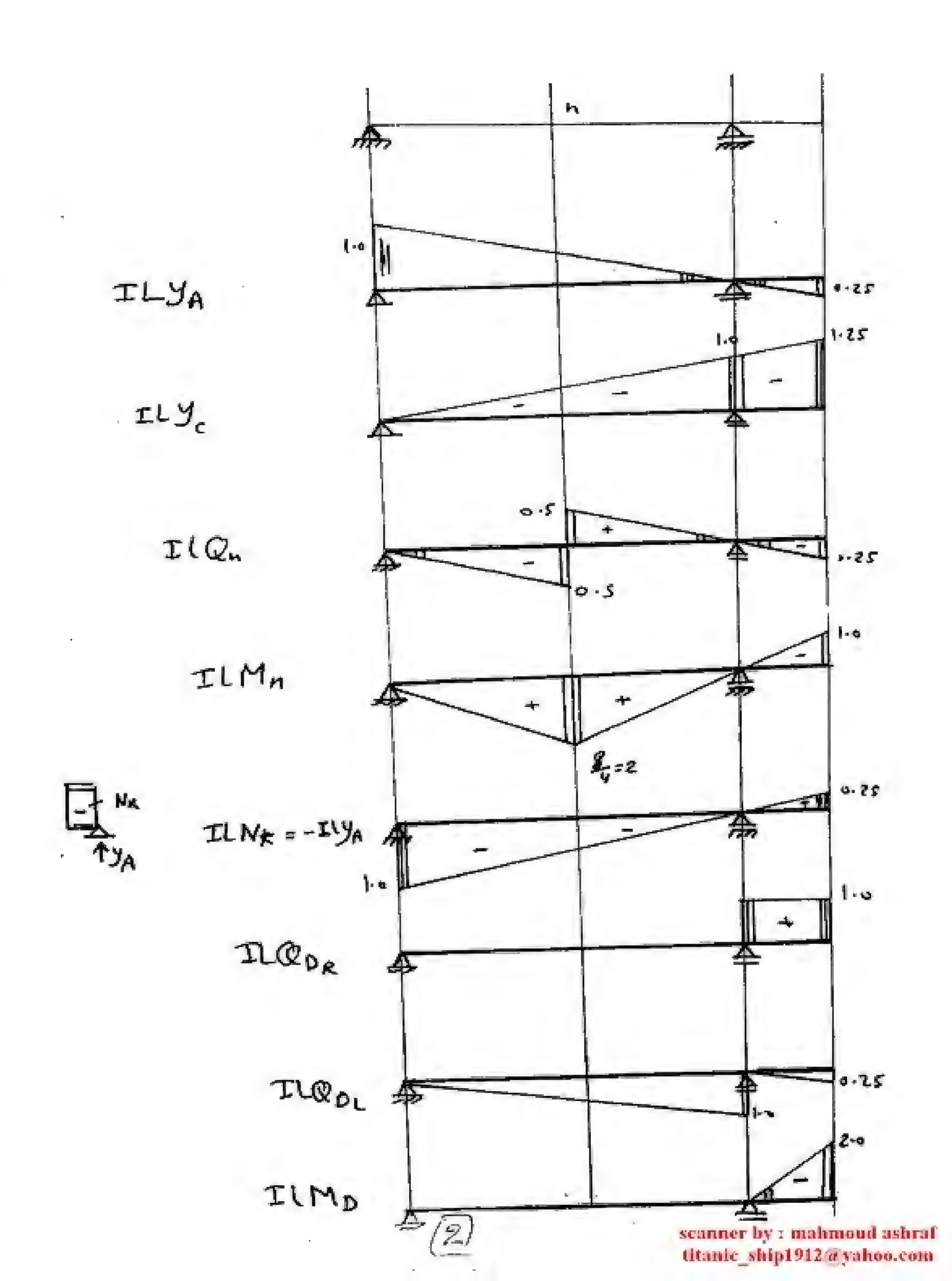
— Sol —

لاحظ أن الأحمال فى Influnce دائما vertical load ⇐ $X_A = 0.0$

الجزء AB , CD ⇐ ليس عليها عزوم ⇐ تعمل كـ Link member

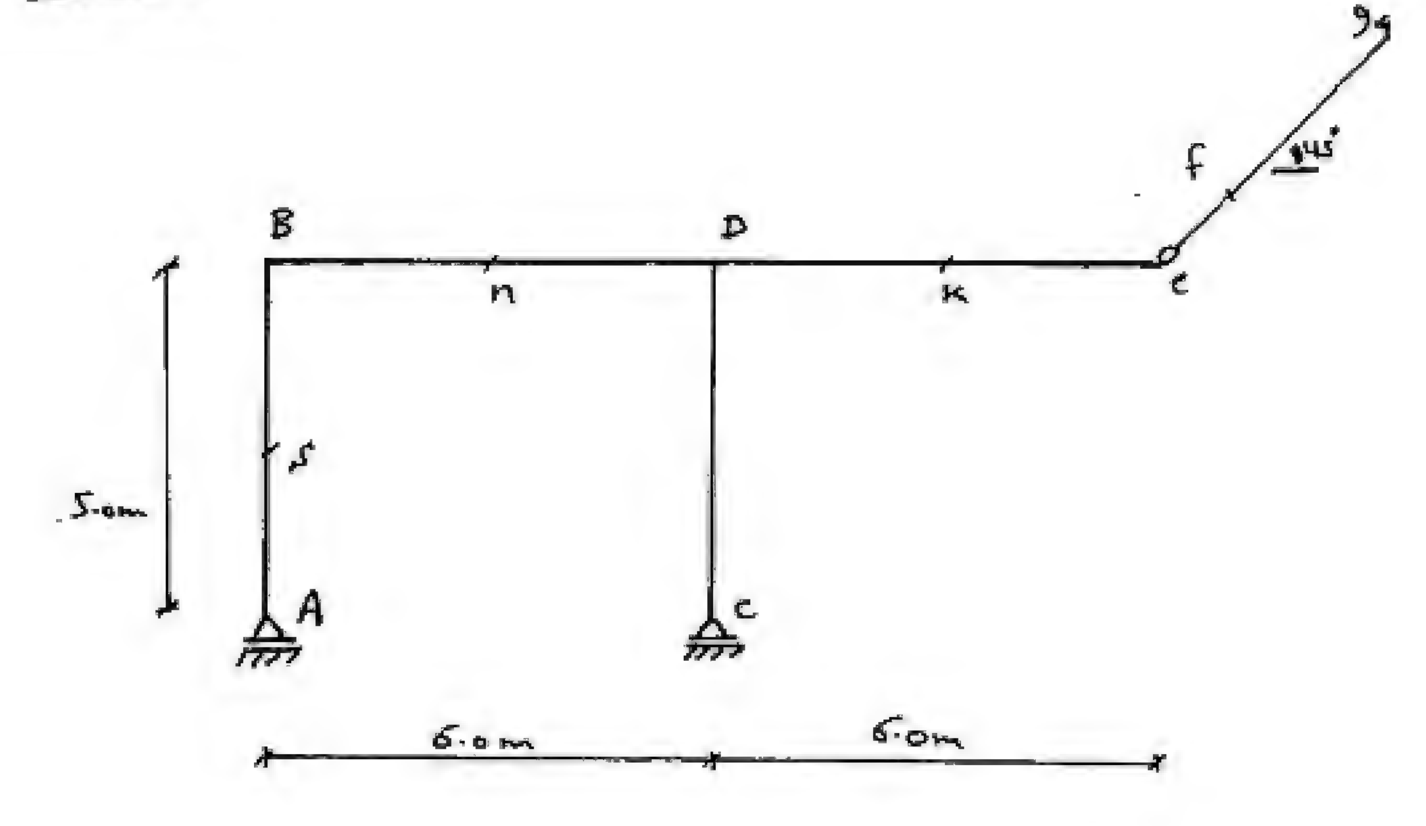
⇐ كأنه وضع hinge عند (B, D) نقطة تتحول

كـ beam عادية .



n
ILY_A
1.0
0.25
ILY_C
1.0
1.25
ILQ_n
0.5
0.5
0.25
ILM_n
1.0
ℓ/4=2
N_K
Y_A
ILN_K = -ILY_A
0.25
1.0
ILQ_DR
1.0
ILQ_DL
0.25
1.0
ILM_D
2.0
2

Final 2003



Required IL y_A, y_c, N_s, Q_n, M_n
Q_{DL}, Q_{DR}, M_D, Q_K, M_K, N_f

– Sol –

$F\sin\theta$ ↑ F → $F\cos\theta$ ⇐ Link (eg) لاحظ

$F\cos\theta = 0.0$ (45°) ⇐ لاحظ لا يوجد قوى أفقيه

⇒ $F = 0.0$

⇒ لا وجود لل (link)

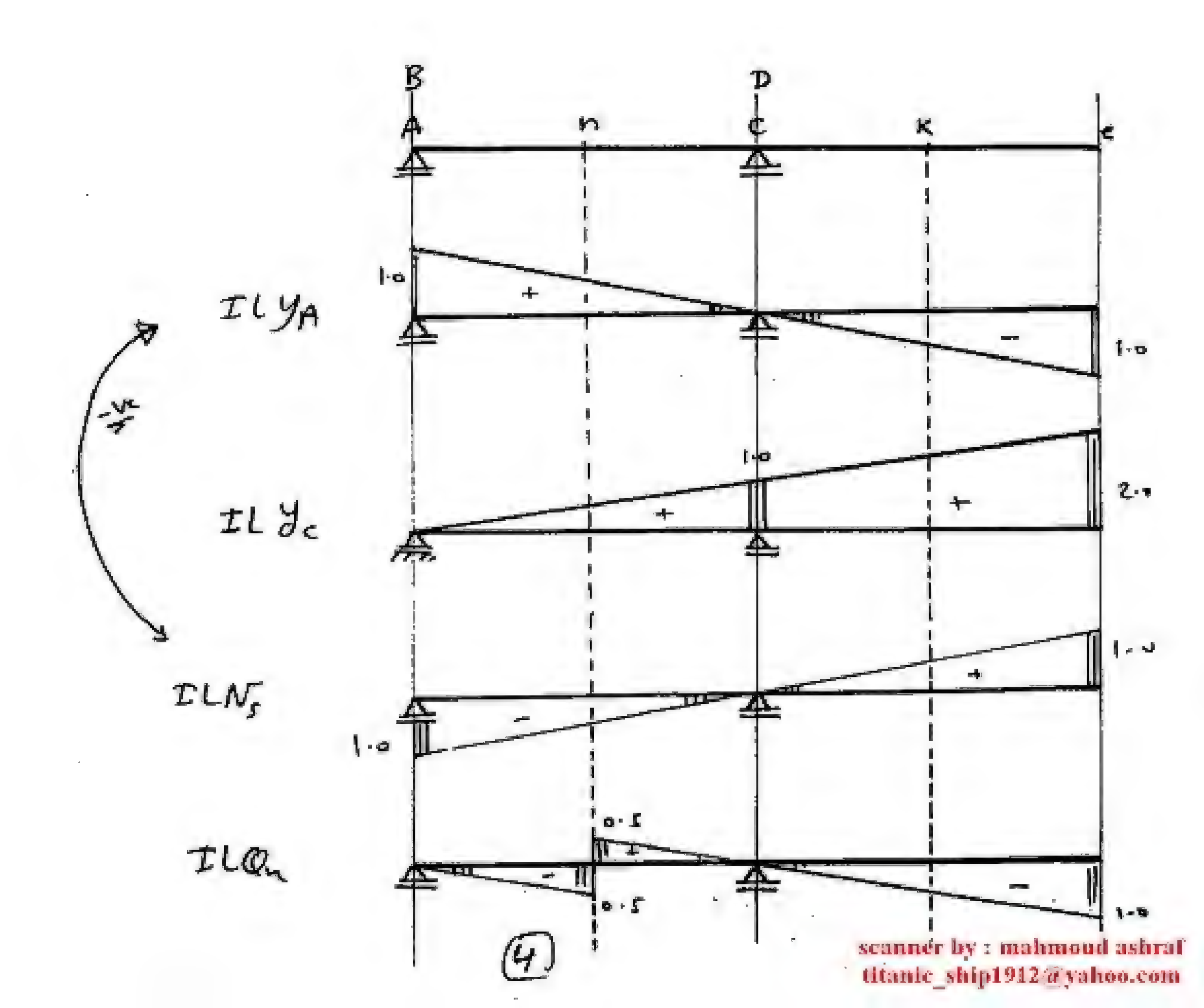
الشكل الناتج

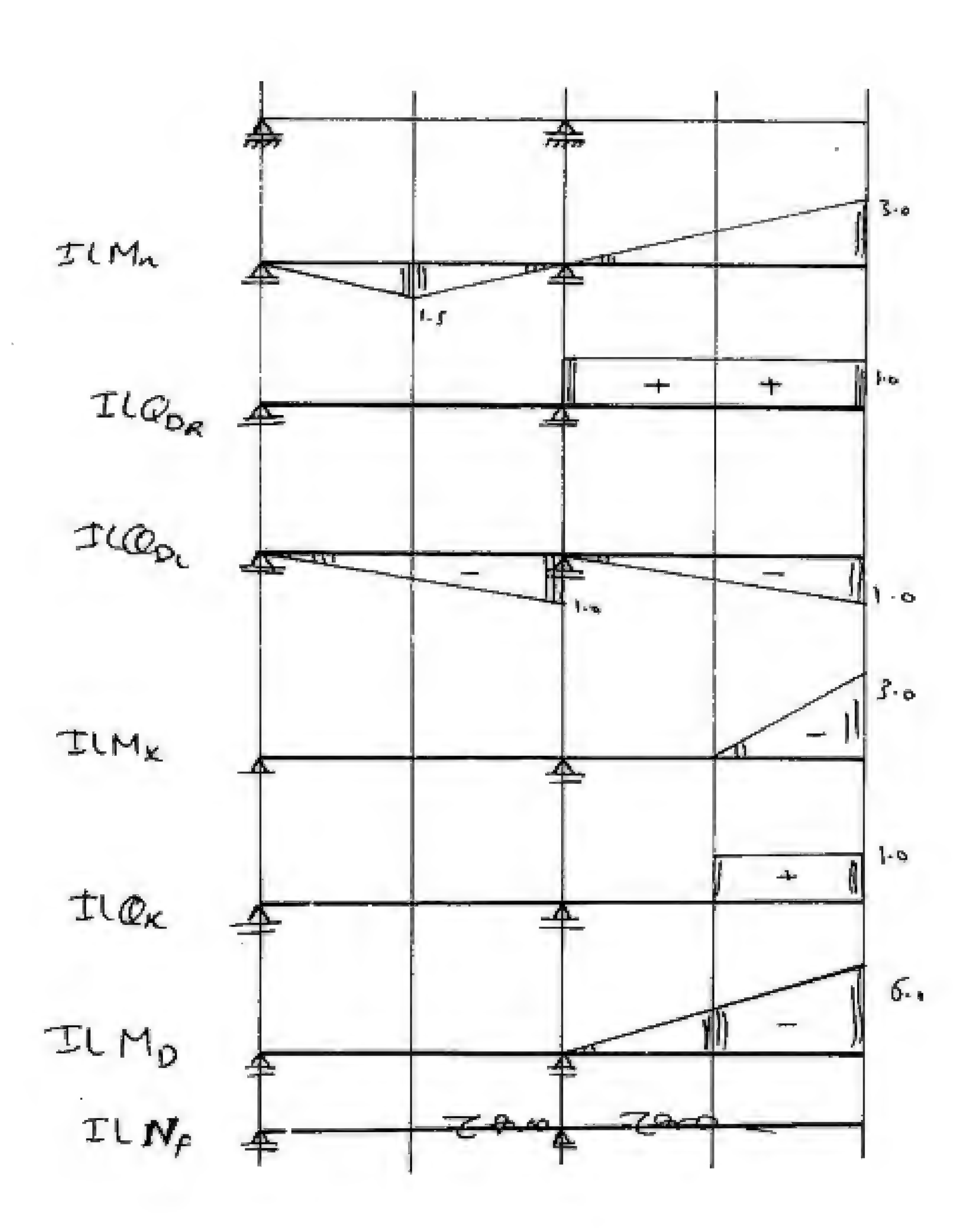
نزيل الـ frame

مثل المسألة السابقة

$$IL\,N_f = 0.0$$

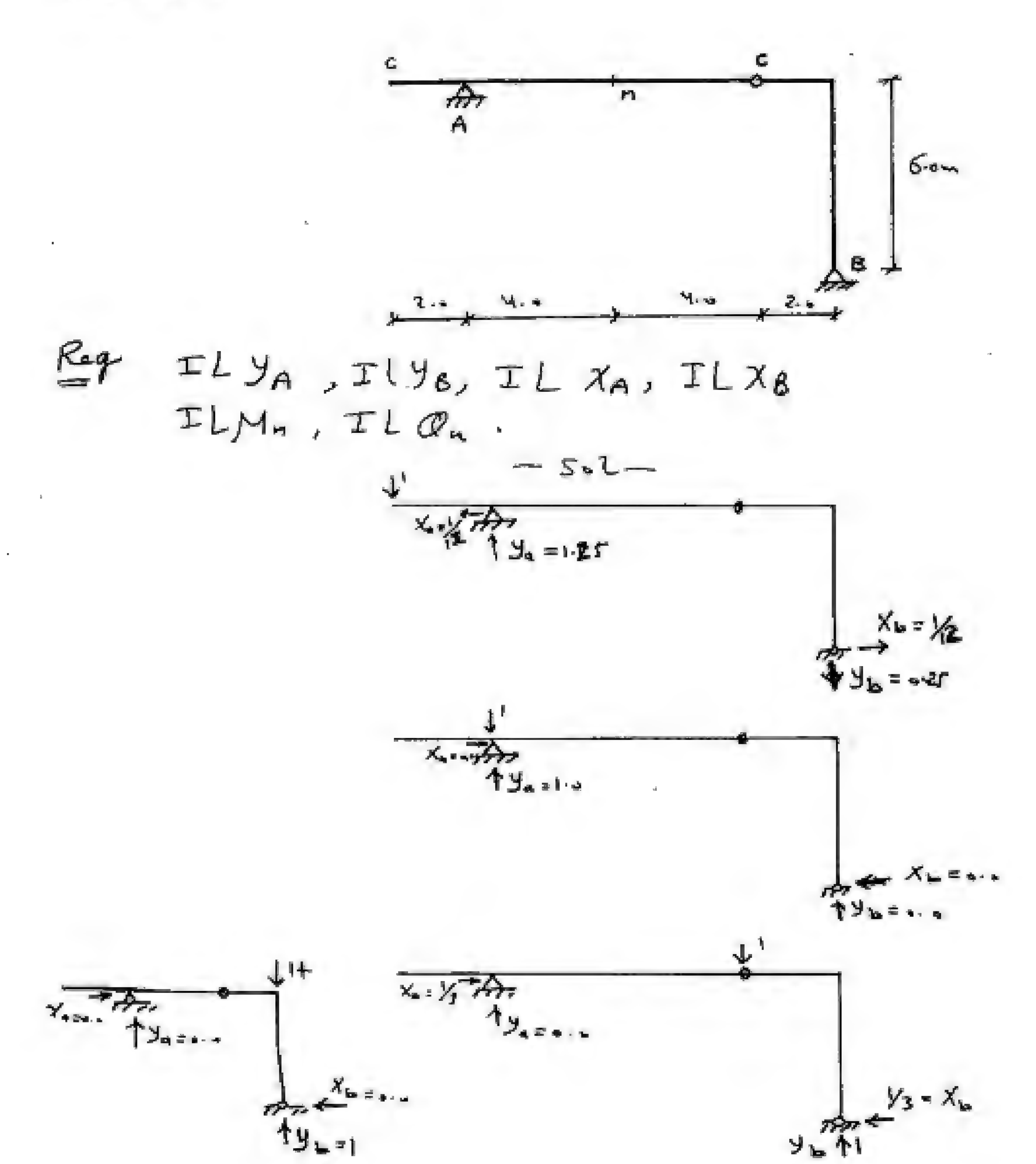
$$IL\,N_s = -\,IL\,Y_A$$



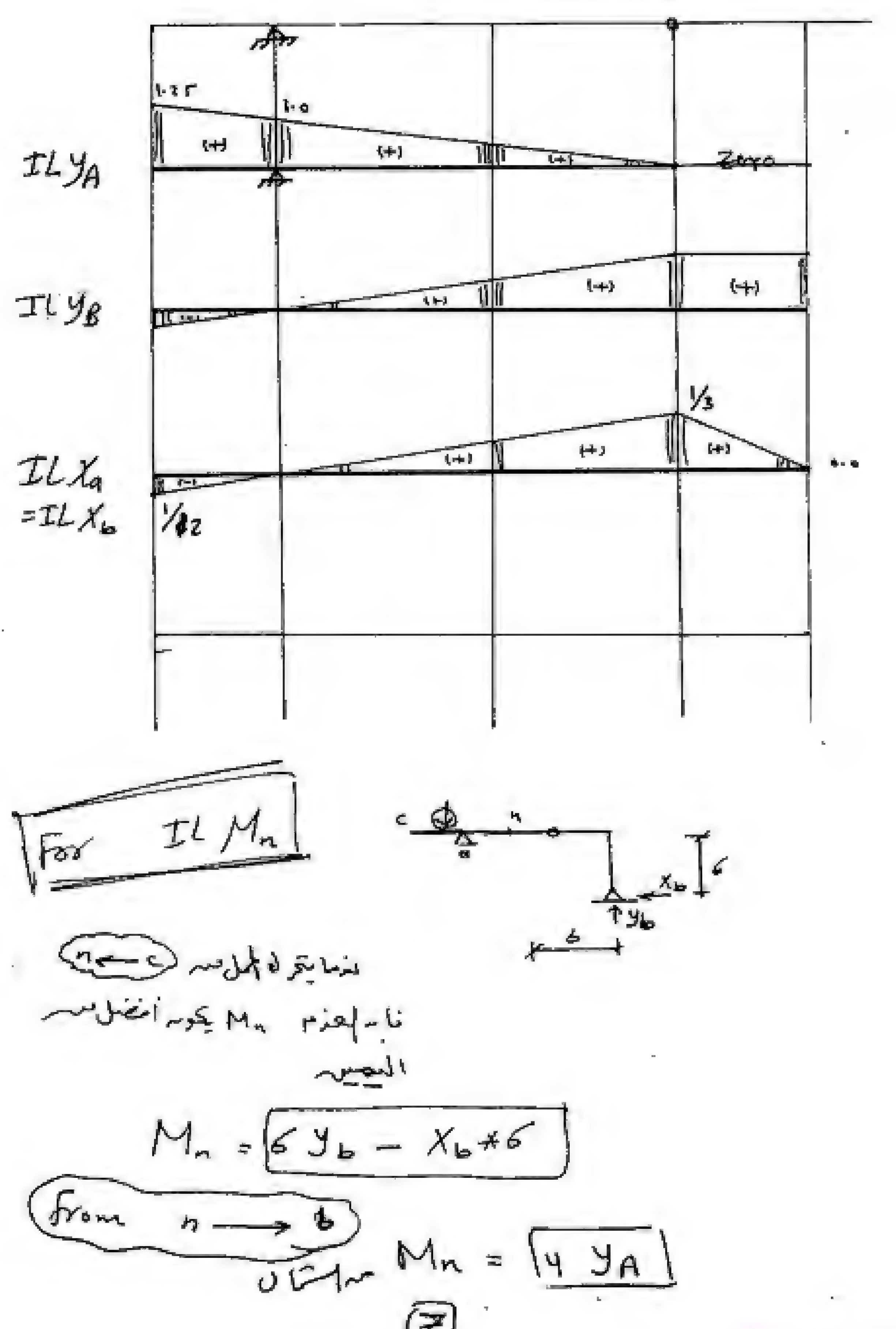


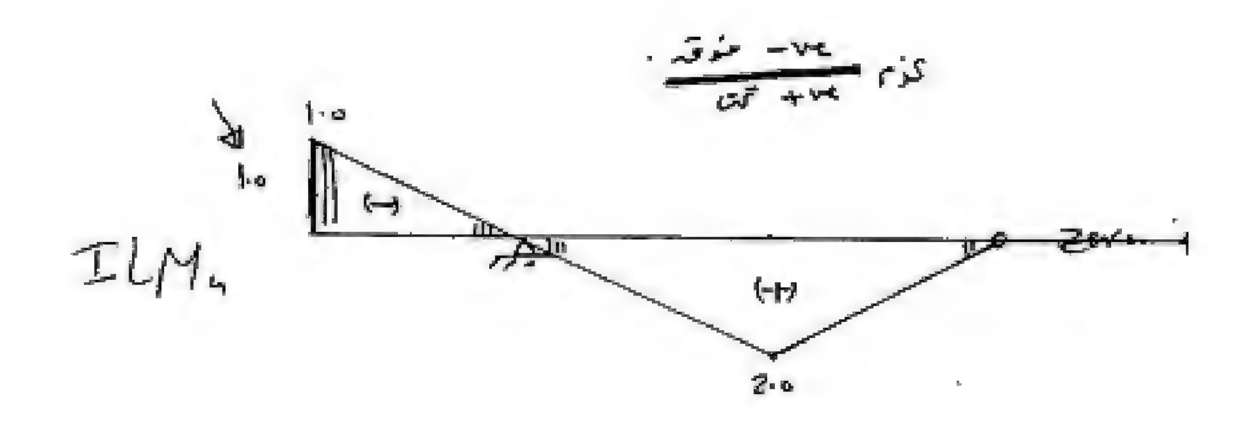
ILMn
3.0
1.5
ILQDR
1.0
ILQDL
1.0
1.0
ILMk
3.0
ILQk
1.0
ILMD
6.0
ILNf

Example ③

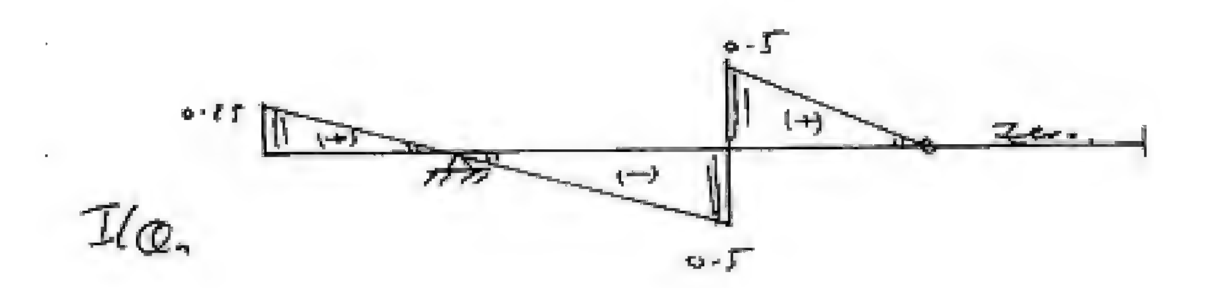


A
B
6.0m
Req
IL y_A , IL y_B , IL X_A , IL X_B
IL M_n , IL Q_n .
— Sol —
$y_a = 1.25$
$X_b = 1/12$
$y_b = 0.25$
$y_a = 1.0$
$y_b = 1$
$y_3 = X_b$

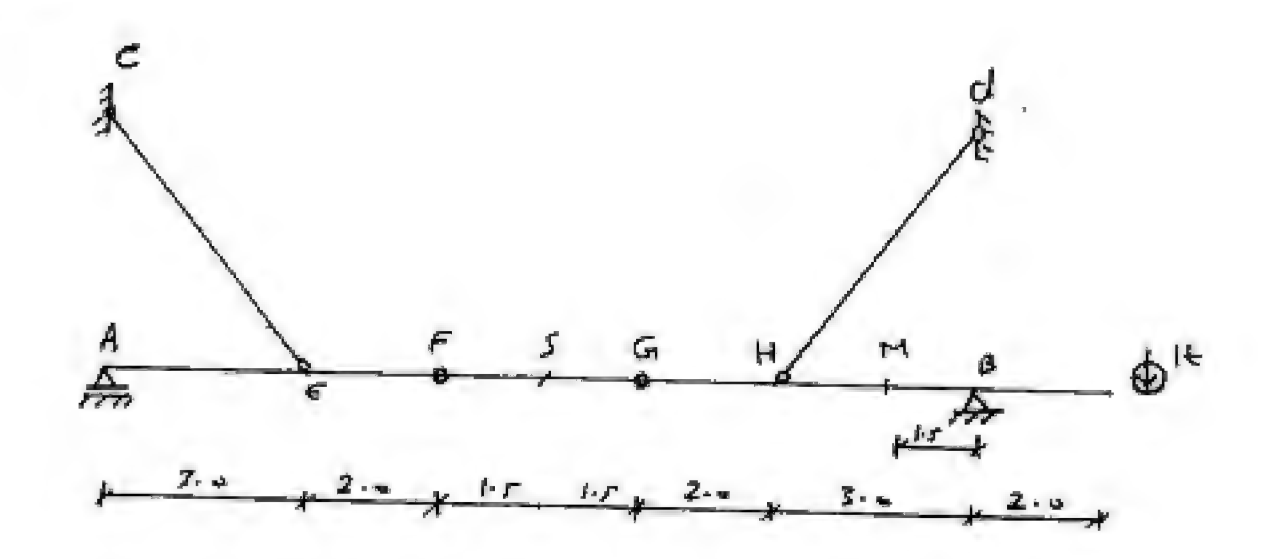

1.25
1.0
IL YA
Zero
IL YB
1/3
IL Xa
=IL Xb
For IL Mn
Mn = 6 Yb − Xb * 6
from n → b
Mn = 4 YA
7


1.0
1.0
(-)
ILM
(+)
2.0
Zero


For Q

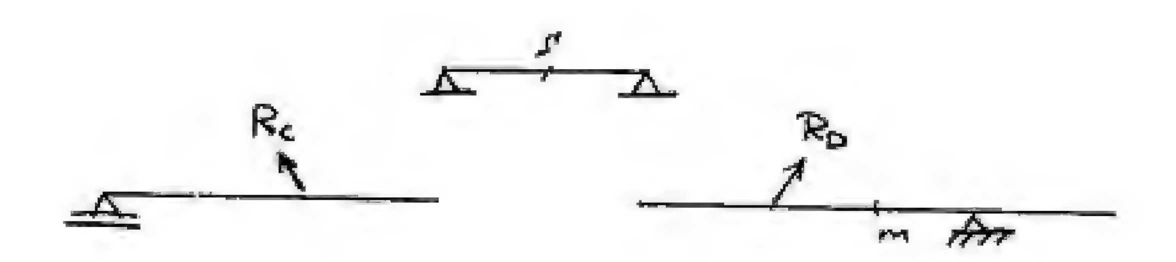

0.25
(+)
0.5
(+)
Zero
(-)
0.5
ILQ

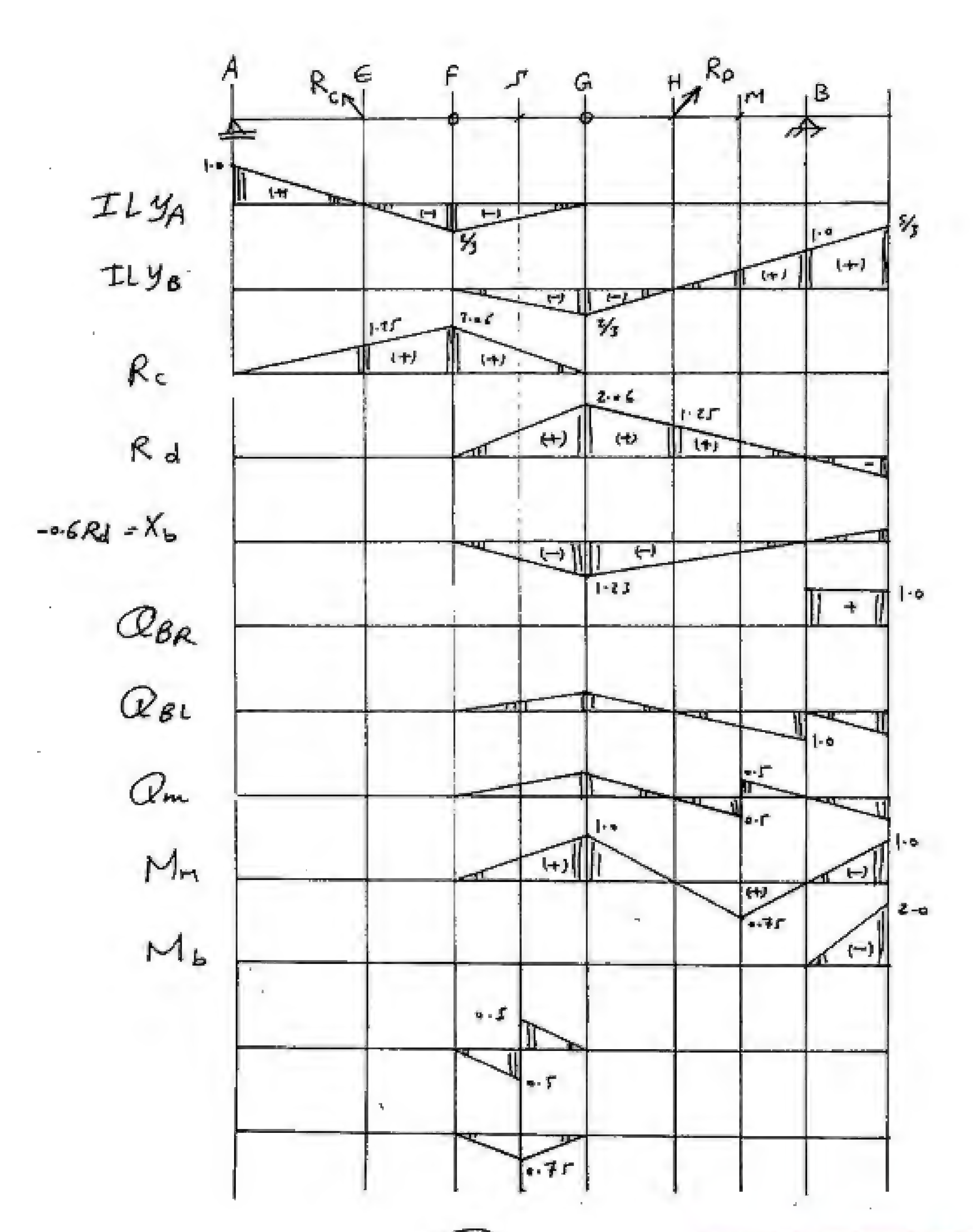
2004 [illegible]



draw influnce lines of Y_A, Y_B, R_c, R_d
X_b, Q_{Br}, Q_{BL}, Q_m
M_b, M_m, Q_s and M_s

— Sol —




A
R_C
E
F
S
G
H
R_D
M
B
1.0
ILY_A
5/3
ILY_B
5/3
1.0
5/3
R_c
1.25
2.06
R_d
2.06
1.25
$-0.6R_d = X_b$
1.23
Q_{BR}
1.0
Q_{BL}
1.0
Q_m
0.5
0.5
M_M
1.0
0.75
1.0
M_b
2.0
0.5
0.5
0.75

Final 2006

A D E S C

T B

3.0 m

4.0 4.0 2.0 3.0 3.0 2.0

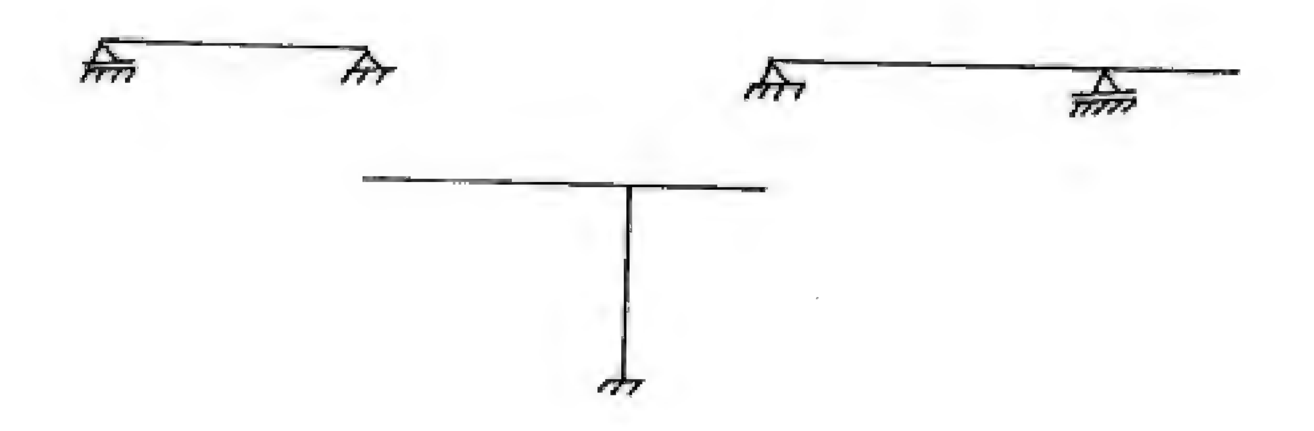
10t 8t 8t

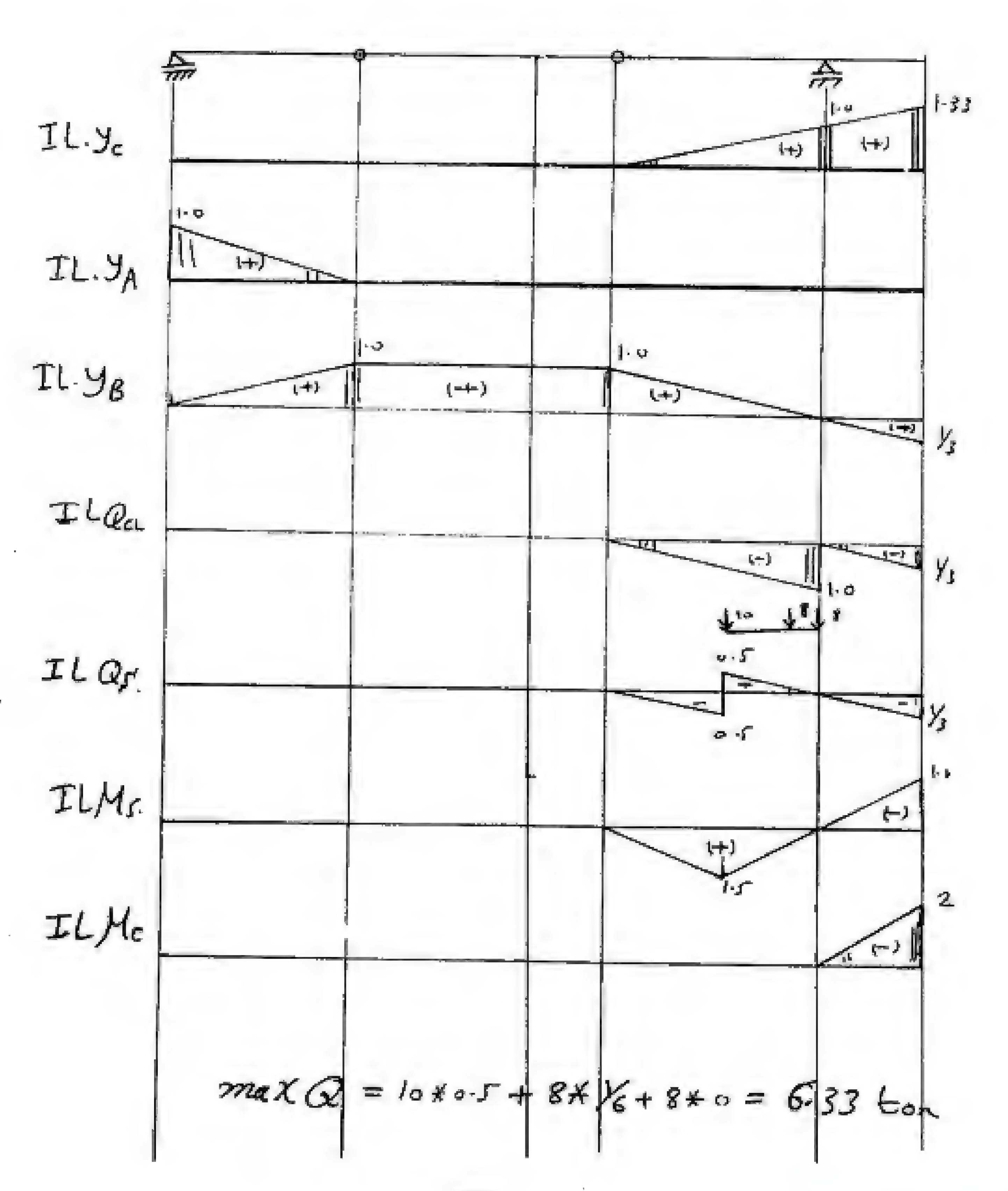
2.0 1.0

(i) draw the influnce lines of y_a, y_b, y_c, Q_{CL}, M_B, M_C, Q_S and M_S

(ii) determine the max Q_S due to the given Loading system.

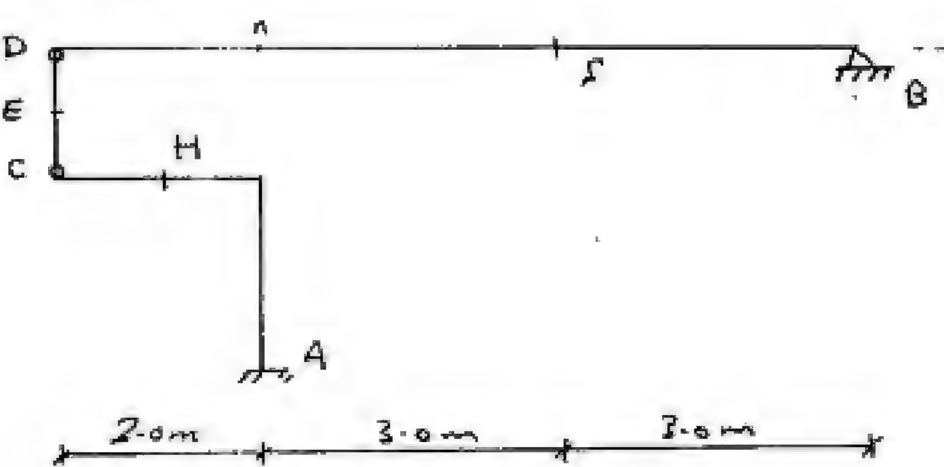
—— SoL ——





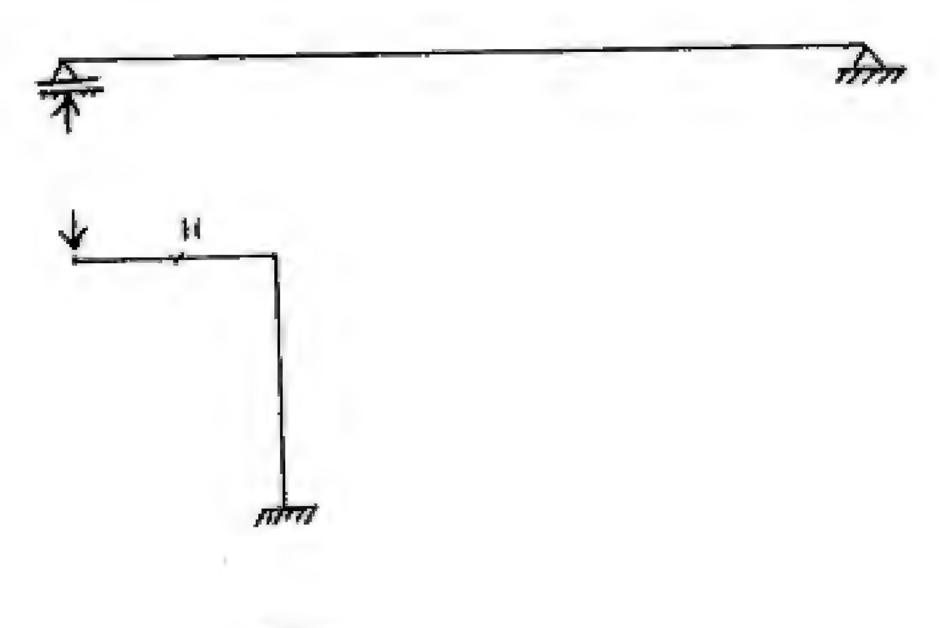
$$max\ Q = 10 * 0.5 + 8 * 1/6 + 8 * 0 = 6.33\ ton$$

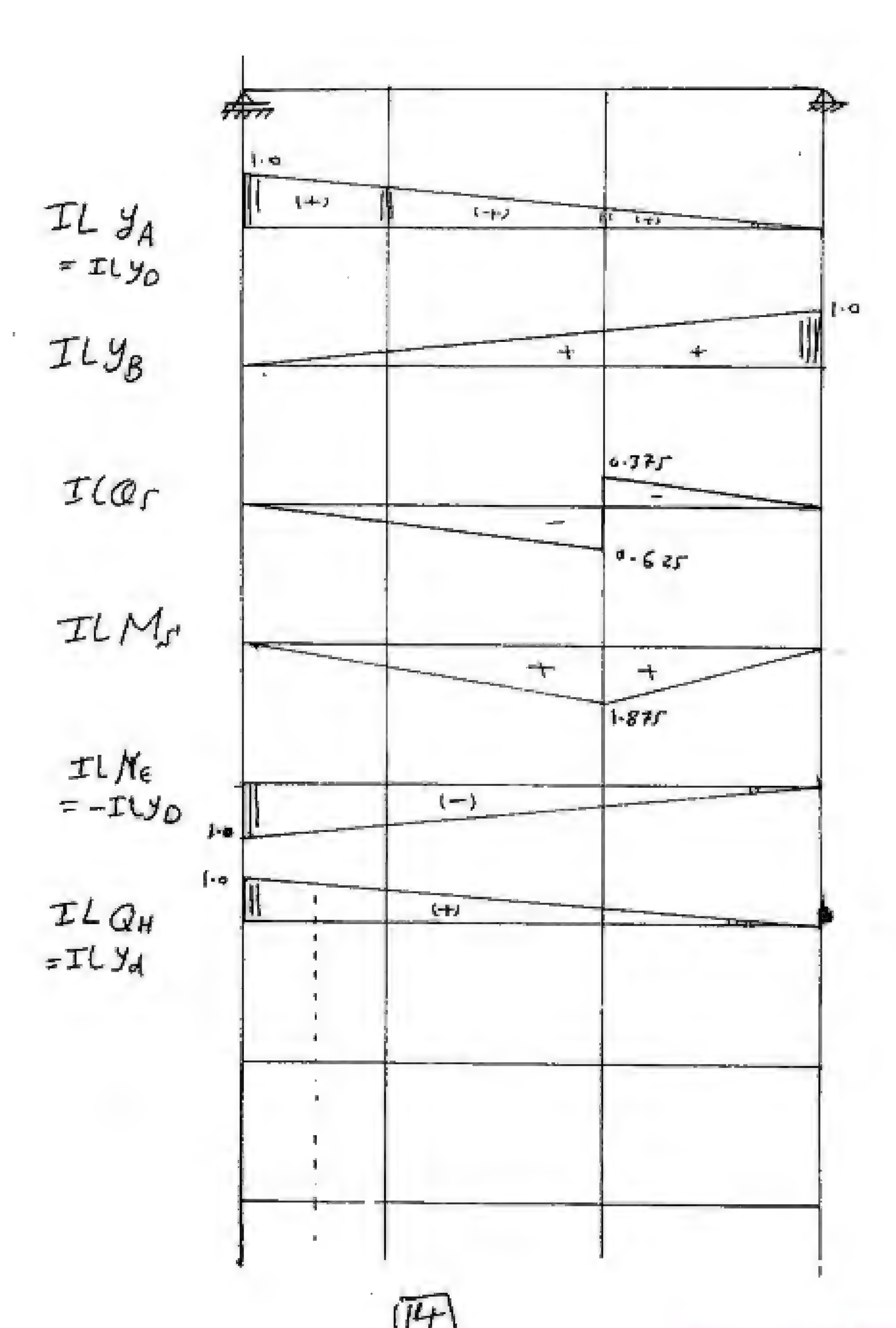
final 2007



draw IL y_A, y_B, y_D, M_A, Q_s, M_s, N_G, Q_H for the shown frame.

— Sol —

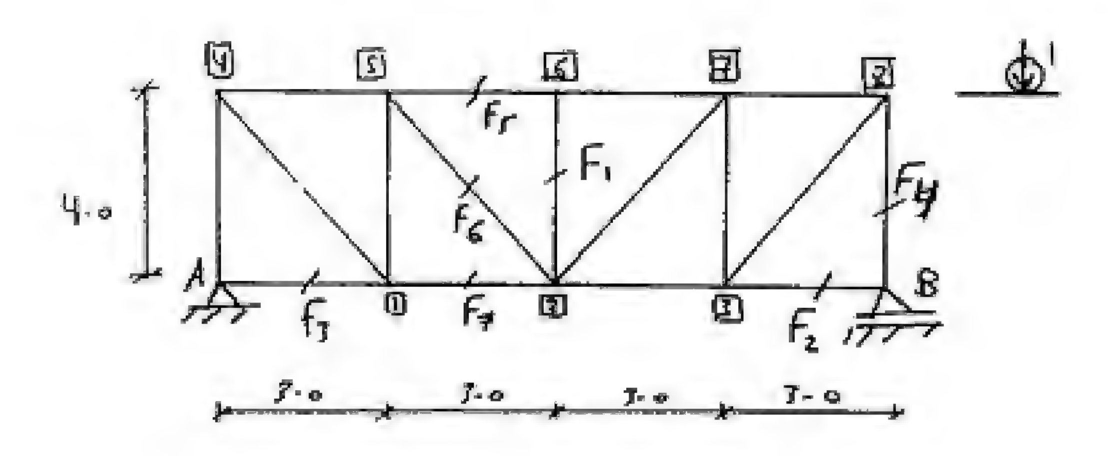



IL y_A = IL y_D
1.0
(+)
IL y_B
1.0
+
IL Q_S
0.375
0.625
−
IL M_S
+
1.875
IL M_E = −IL y_D
(−)
1.0
IL Q_H = IL y_A
1.0
(+)

13

truss

Cont. to Influnce



* لاحظ أن الحمل إذا وضع في نقاط 1 أو 5 ⇐ $F_1 = 0.0$

أو 7 أو 8 ⇐ $F_1 = 0.0$

ولكن لما يوضع الـ 1t عند 6

1t

$F_1 = 1.0$

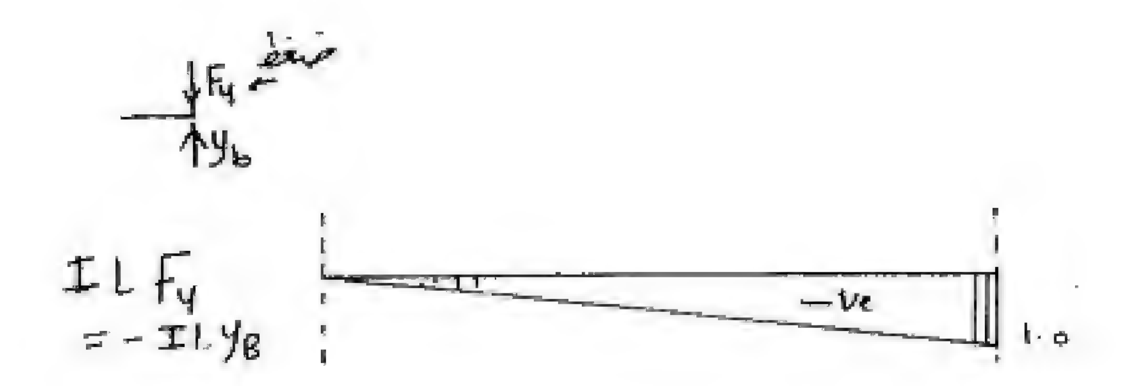
ضغط $F_1 = -1\ ton$

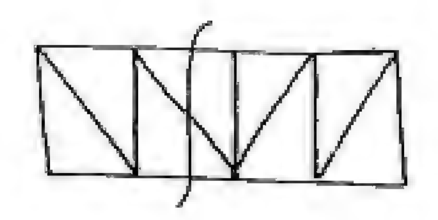
$IL\ F_1$: zero — -1 — zero

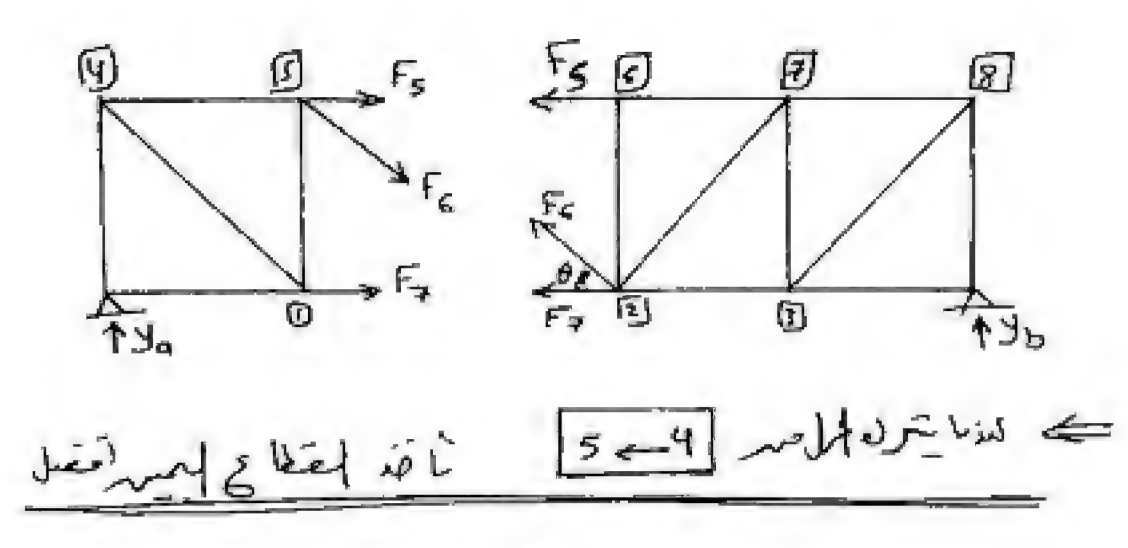
$IL\ F_2 = F_3$: zero

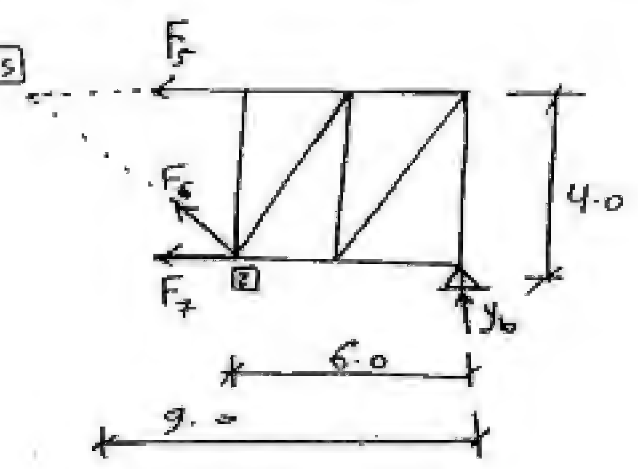
$IL\ Y_A$: 1.0 (+)

$IL\ Y_B$: 1.0 (+)









$\Rightarrow \Sigma M_2 = 0.0$

$4 \cdot F_5 + 6\, y_b = 0.0$

$F_5 = -1.5\, y_b$

$\Rightarrow \Sigma M_5 = 0.0$

$4 F_7 = 9 y_b$

$$\boxed{F_7 = 2.25 y_b}$$

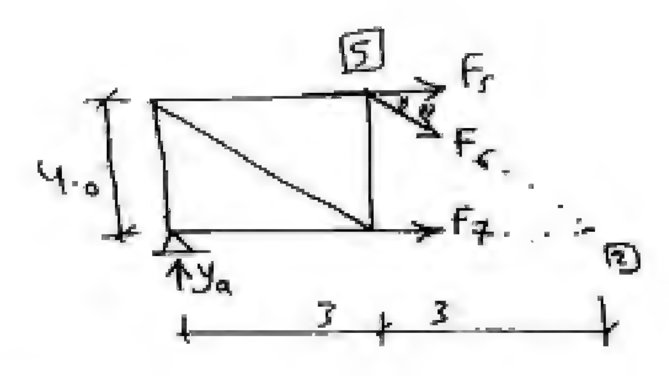
$\Rightarrow \Sigma y = 0.0$

$F_6 \sin\theta + y_b = 0.0$

$$F_6 = -1.25 y_b$$



آخر جزء أشمال



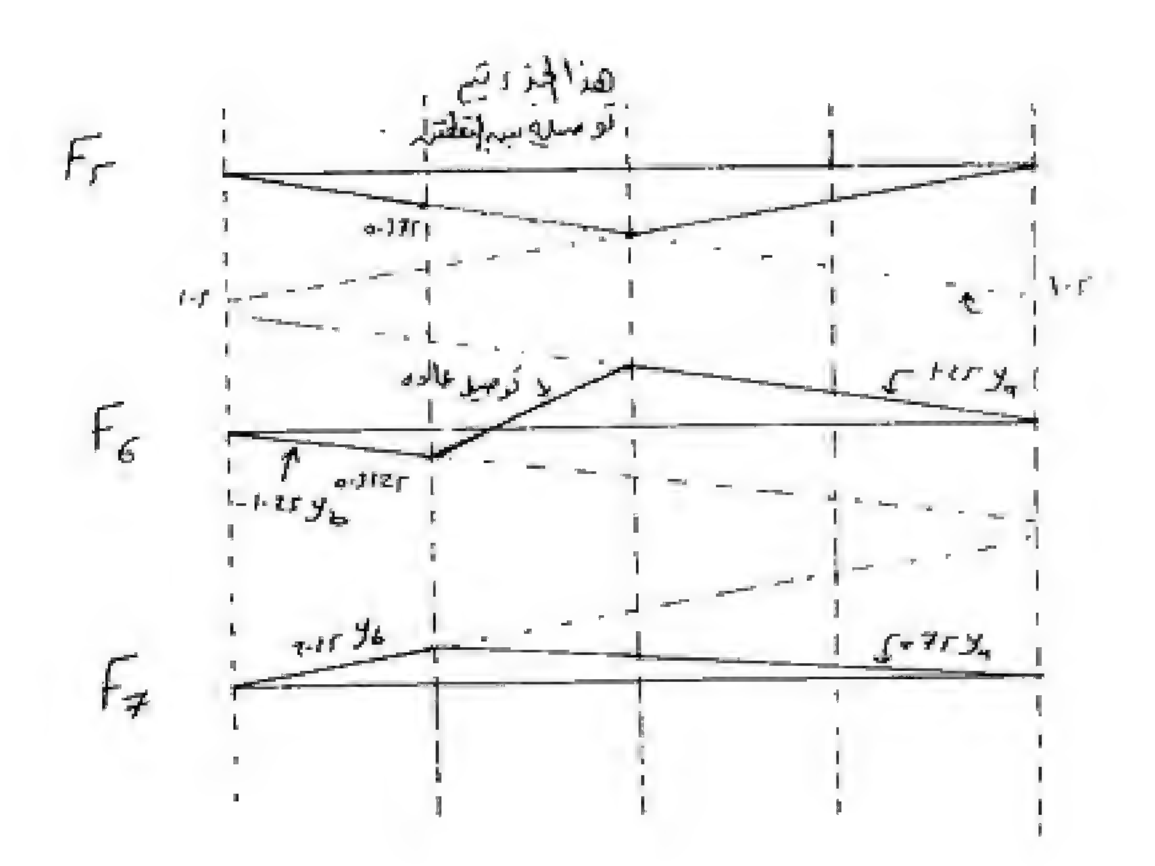
$\Sigma M_2 = 0.0$ $\Rightarrow 4 F_5 + 6 y_a = 0.0$

$$\boxed{F_5 = -1.5 y_a}$$

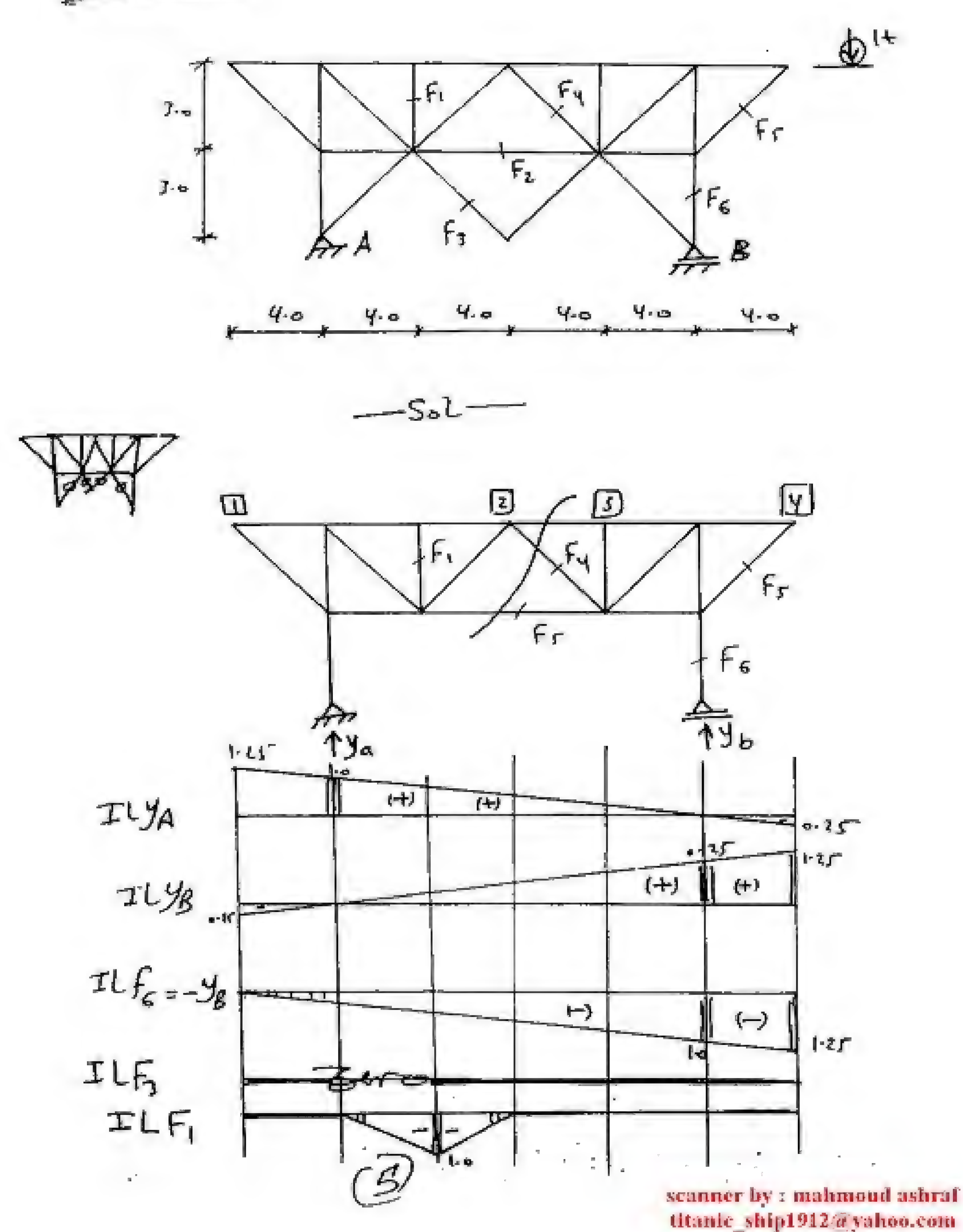
$\Sigma M_5 = 0.0$ $\Rightarrow 3 y_a = 4 F_7 \Rightarrow \boxed{F_7 = 0.75 y_a}$

$\Sigma y = 0.0$ $\Rightarrow F_6 \times 0.8 = y_a$

 $\Rightarrow \boxed{F_6 = 1.25 y_a}$



final 2007


1t
F1
F4
F5
F2
F3
F6
A
B
3.0
3.0
4.0
4.0
4.0
4.0
4.0
4.0
Sol
1
2
3
4
Fs
F6
ya
yb
1.25
1.0
(+)
(+)
ILyA
0.25
ILyB
1.25
(+)
(+)
ILf6 = -yB
(-)
(-)
1.25
ILF3
Zero
ILF1
1.0
(3)

From [1] → [2]



$\Rightarrow \Sigma M_2 = 0.0$

$8 y_b = 3 F_2$

$\boxed{F_2 = 2.67\, y_b}$

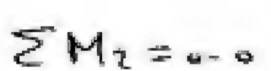
$\Rightarrow \Sigma y = 0.0$

$F_4 = -\dfrac{y_b}{0.6} = -1.67\, y_b$

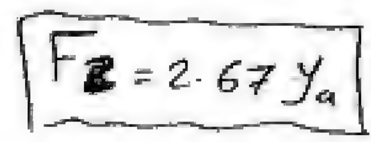
$\boxed{F_4 = -1.67\, y_b}$

From [3] → [4]

2
F4
F2
ya



$\Sigma M_2 = 0.0$



$\boxed{F_2 = 2.67\, y_a}$



$\Sigma y = 0.0$

$0.6\, F_4 = y_a$

$\boxed{F_4 = 1.67\, y_a}$

2.67 y_a

1.33

2.67 y_b

ILF_2

(+)

(+)

(-)

0.4167

ILF_4

(+)

(+)

(+)

(-)

0.833

ILF_5

Zero

1.25

قوة = صفر

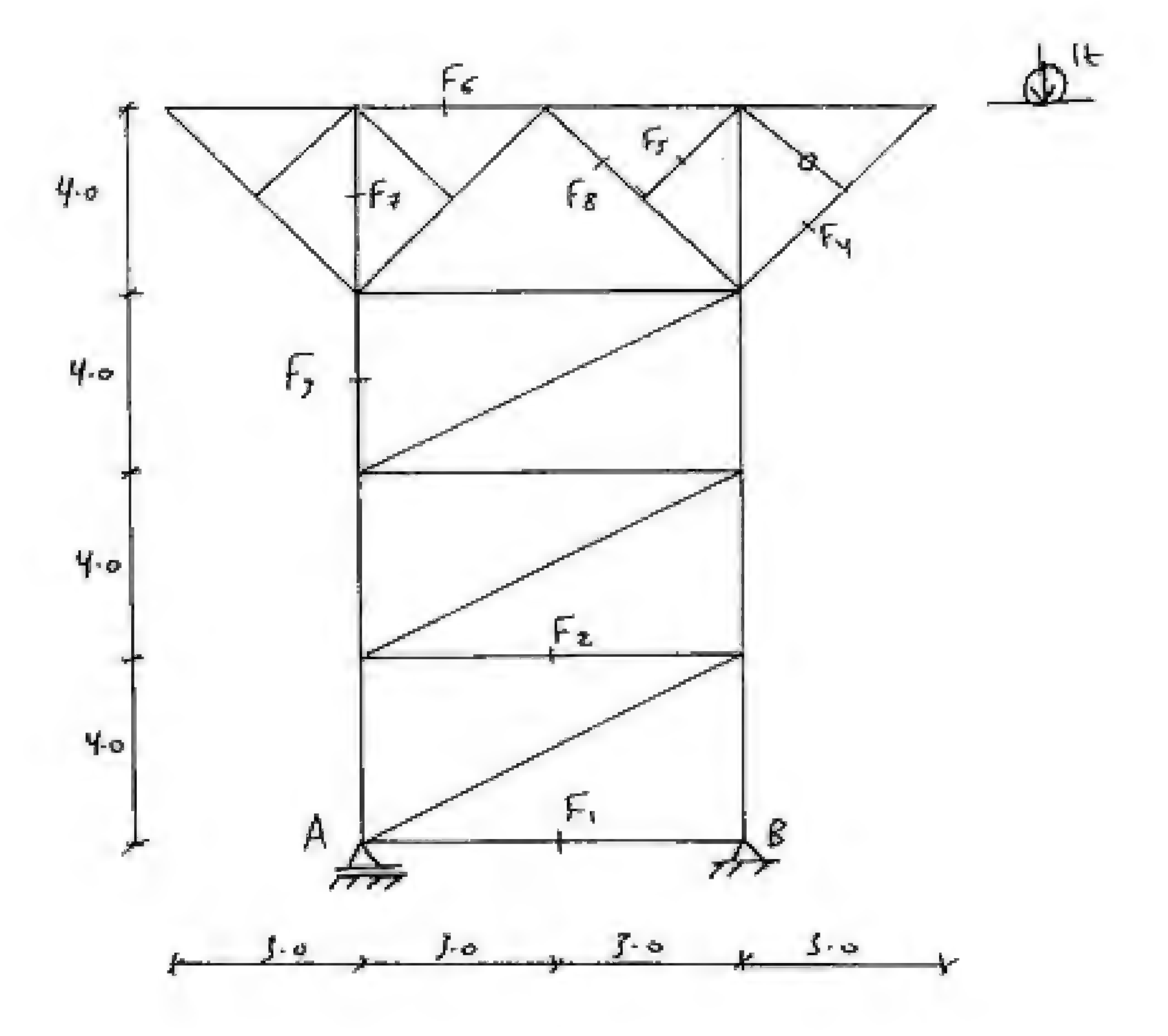
1

1.25

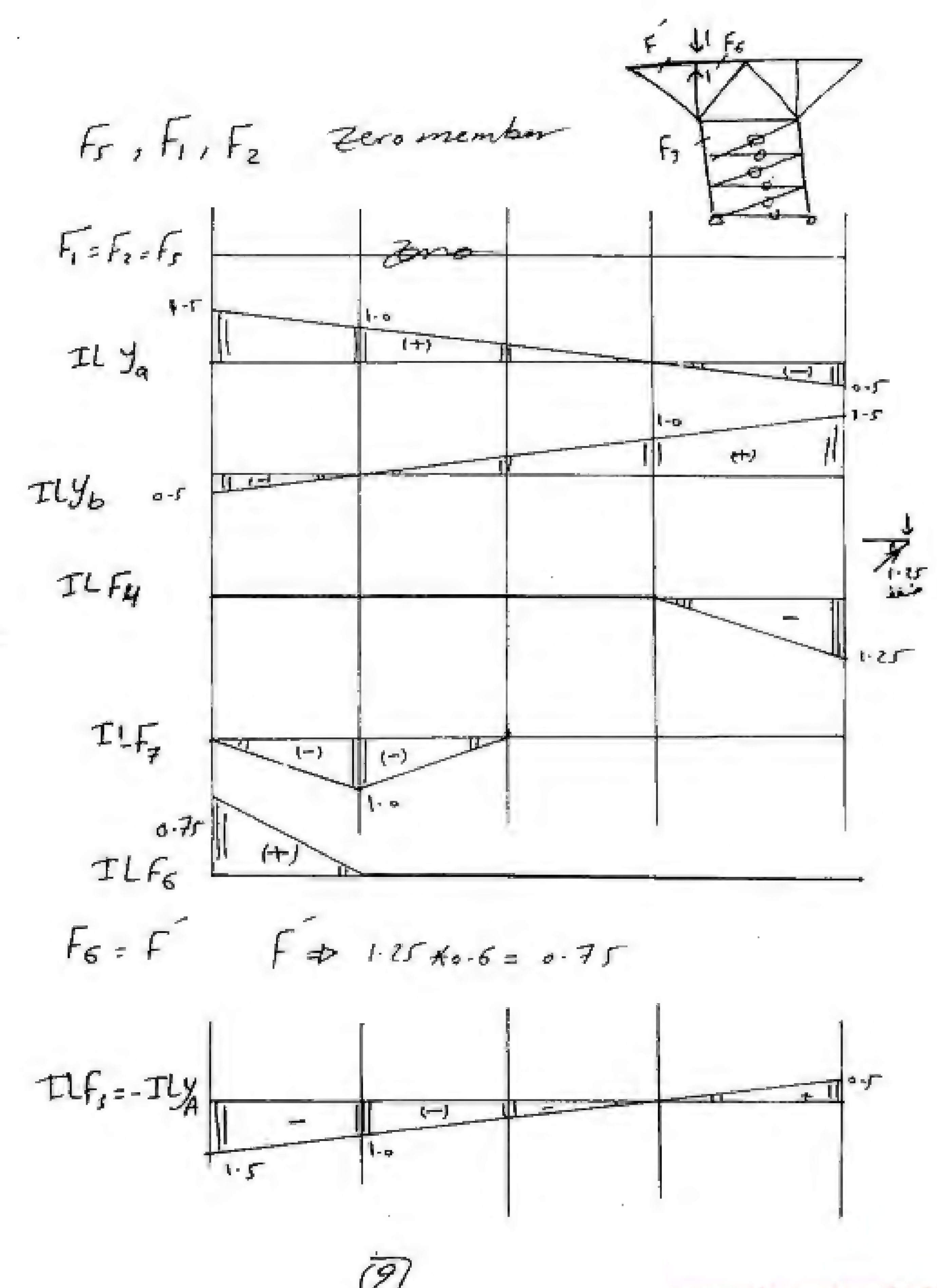
ضغط

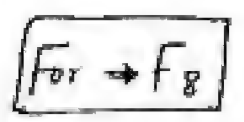


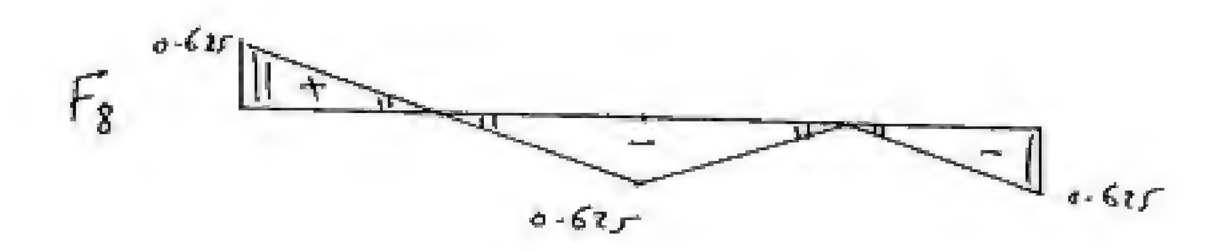
final 2004

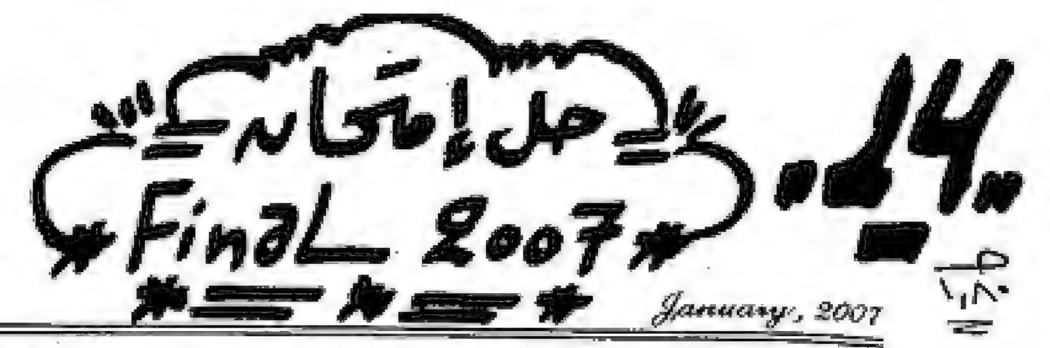


draw IL Y_A, Y_B and Internal Force


F'
1
F6
1
F7
F5 , F1 , F2 Zero member
F1 = F2 = F5
Zero
1.5
1.0
(+)
IL ya
(−)
0.5
1.5
1.0
(+)
ILyb
0.5
(−)
1.25
IL F4
−
1.25
IL F7
(−)
(−)
1.0
0.75
(+)
IL F6
F6 = F'
F' ⇒ 1.25 × 0.6 = 0.75
ILf3 = −ILy/A
−
(−)
−
+
0.5
1.5
1.0


For → F_8


F_8
0.625
+
−
−
0.625
0.625



January, 2007

Zagazig University
Faculty of Engineering
1st Year Civil Eng.

Full Marks: 90 Marks

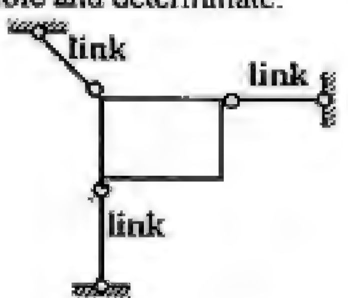
Assume Any Missing Data

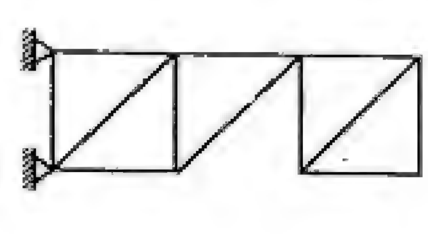
Structural Analysis
Final Term Examination
Date: 21/1/2007.
Time Allowed: 3 Hours

Attempt All problems:

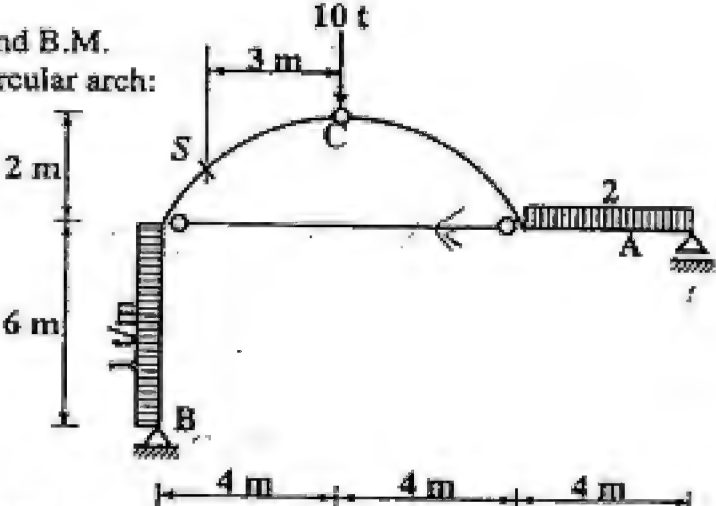
PROBLEM NO. (1): (20 MARK)

a) Check the stability and determinacy for the given structures. If they are unstable or statically indeterminate, show how they can be modified to become stable and determinate.



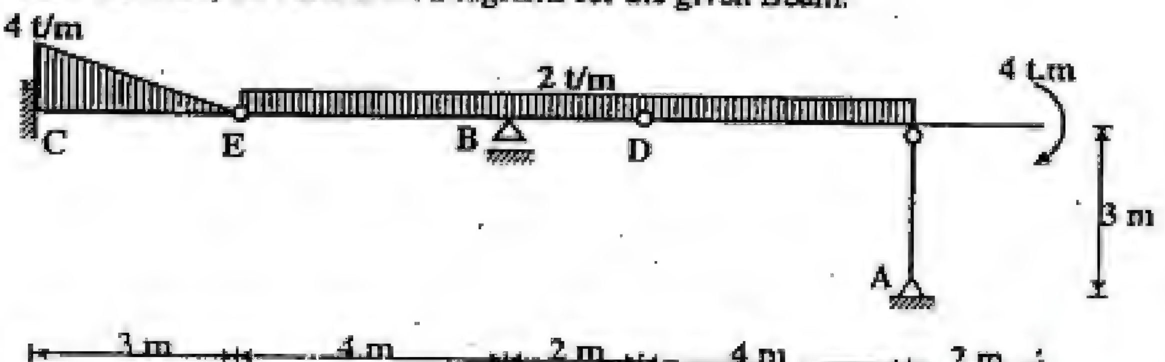


b) Calculate the N.F., S.F. and B.M. at section (*S*) in the given circular arch:



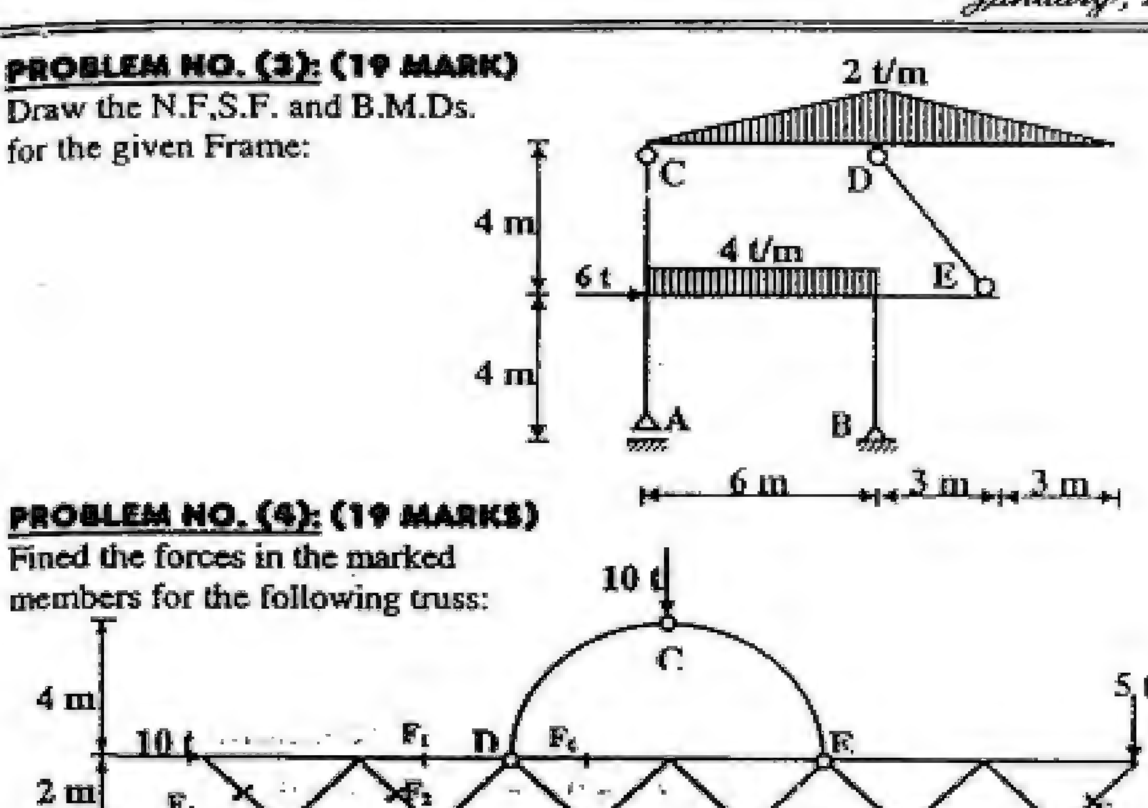
PROBLEM NO. (2): (16 MARK)

Draw the N.F., S.F. and B.M. Diagrams for the given Beam:



PROBLEM NO. (3): (19 MARK)

Draw the N.F,S.F. and B.M.Ds. for the given Frame:



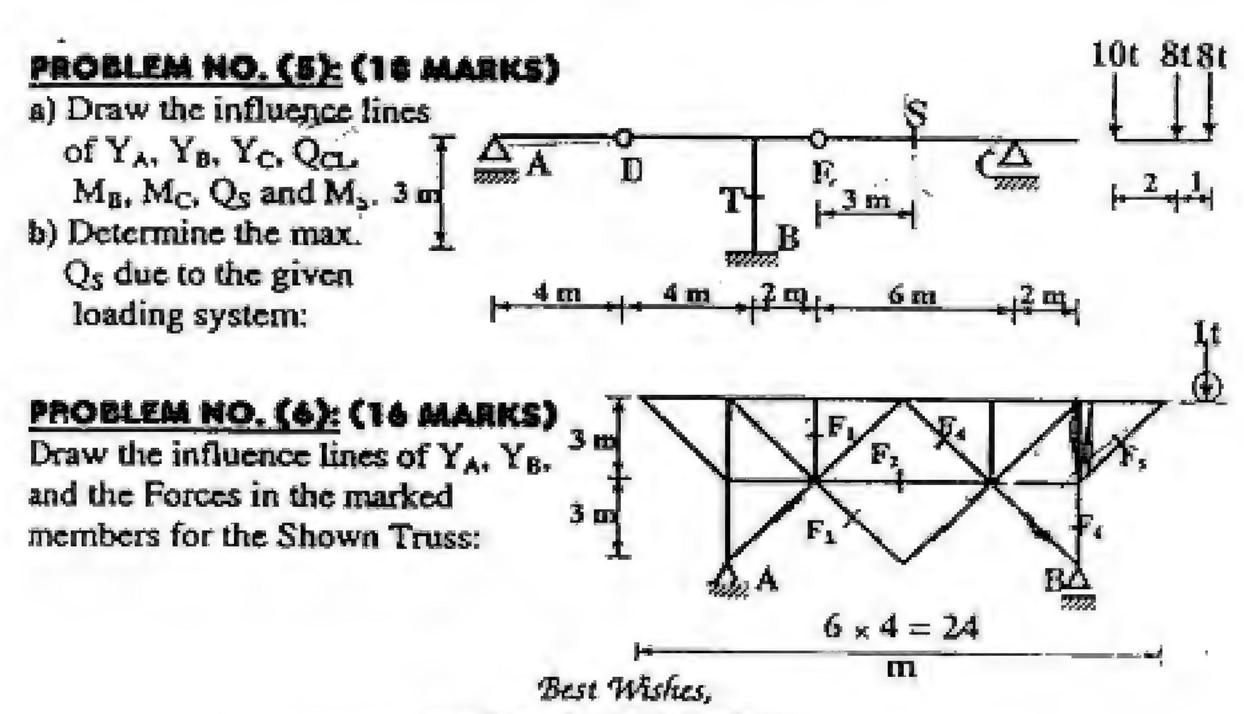
PROBLEM NO. (4): (19 MARKS)

Fined the forces in the marked members for the following truss:

PROBLEM NO. (5): (18 MARKS)

a) Draw the influence lines of Y_A, Y_B, Y_C, Q_{CL}, M_B, M_C, Q_S and M_S.

b) Determine the max. Q_S due to the given loading system:



PROBLEM NO. (6): (16 MARKS)

Draw the influence lines of Y_A, Y_B, and the Forces in the marked members for the Shown Truss:

Best Wishes,

Prof.Dr. Asharf M. El-Shihy

Prof. Dr. Hesham F. Shaat *Dr. Tarek M. Amin*

final 2007

a) check the stability

Structure	Status	modification
A, B, C	Unstable كل الردود الأفعال تلاقيه عند (A)	
A, B, d, c	Unstable جزء ABCD يعتبر كابولي معلق ومرتكز عند (A)	

b)

Req

N.F.D, S.F.D, B.M at section (S) in the given Circular Arch.

-Sol-

Reactions

* $\Sigma X = 0.0$

$\Rightarrow X_B = 6$ ton.

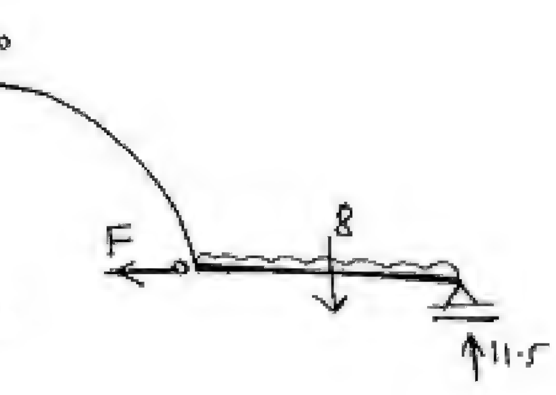
* $\Sigma M_B = 0.0$

$3*6 + 10*4 + 8*10 = y_a * 12$

$y_a = 11.5$ ton.

* $\Sigma y = 0.0$

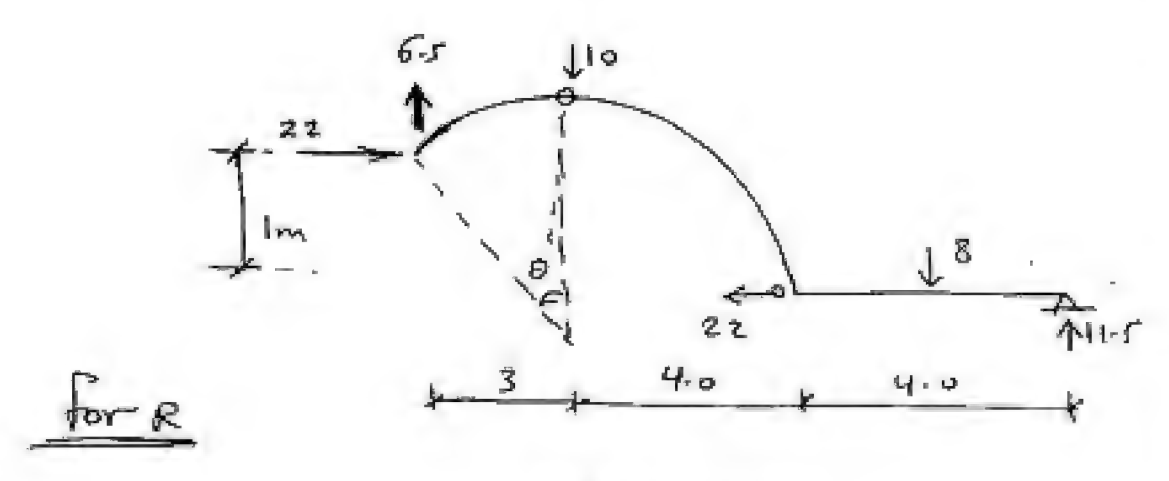
$y_b = 10 + 8 - 11.5 = 6.5$ ton



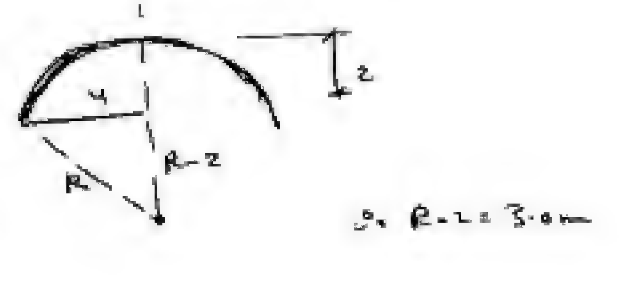
* $\Sigma M_{c_R} = 0.0$

$8*6 + F*2 = 11.5*8$

$F = 22$ ton.



for R



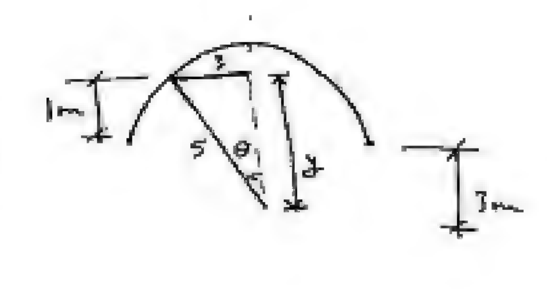
$R^2 = 4^2 + (R-2)^2$

$R^2 = 16 + R^2 - 4R + 4$

$4R = 20$

$R = 5m$

$\therefore R-2 = 3.0m$

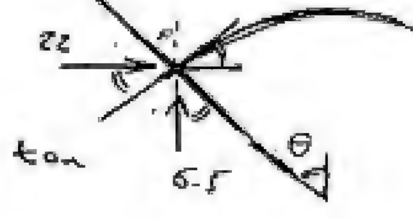


$\theta = \sin^{-1}(3/5) = 36.87^\circ$

$y = \sqrt{5^2 - 3^2} = 4m$

$M_{s'} = 11.5 * 11 - 8 * 9 - 22 * 1 - 10 * 3$

$= 2.5 \ t.m$



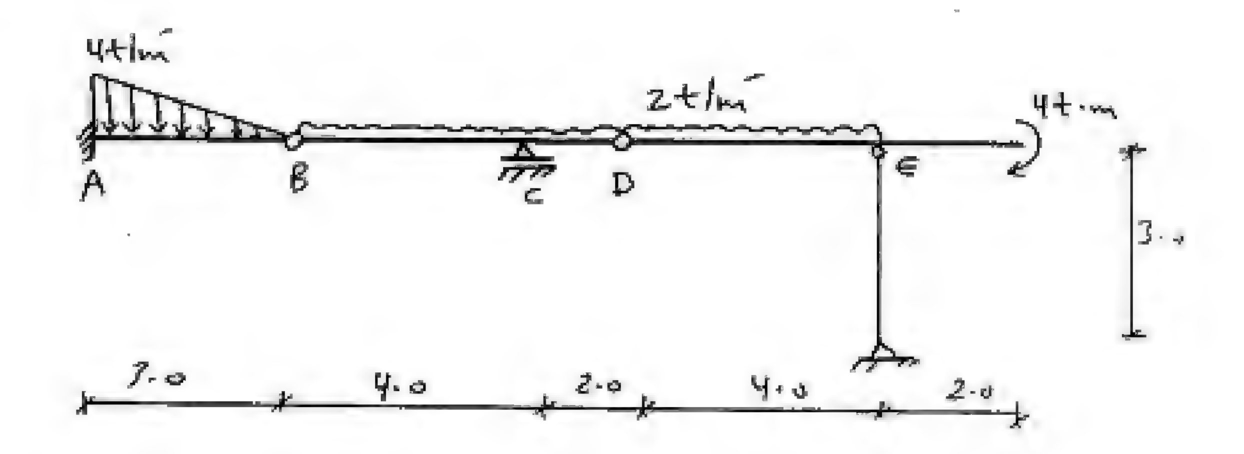
$N_{s'} = 22 \cos\theta + 6.5 \sin\theta$

$= -[22 * 0.8 + 6.5 * 0.6] = -21.5 \ ton$

$Q_s = 6.5 * 0.8 - 22 * 0.6$

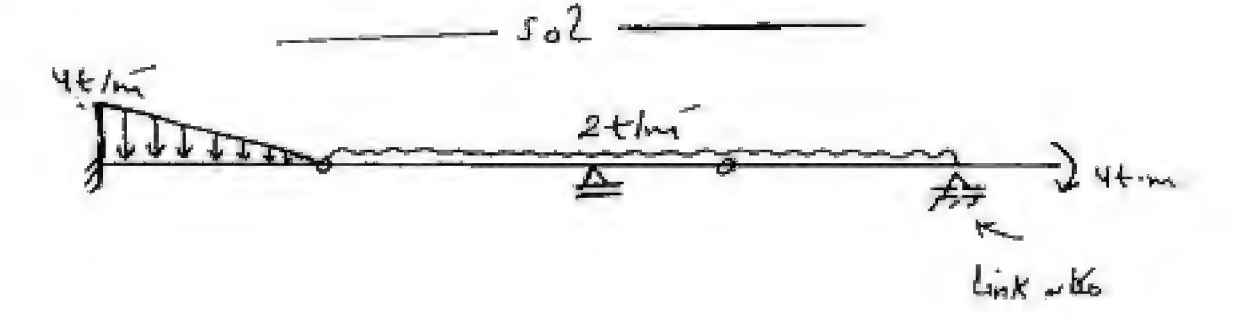
$= -8 \ ton.$

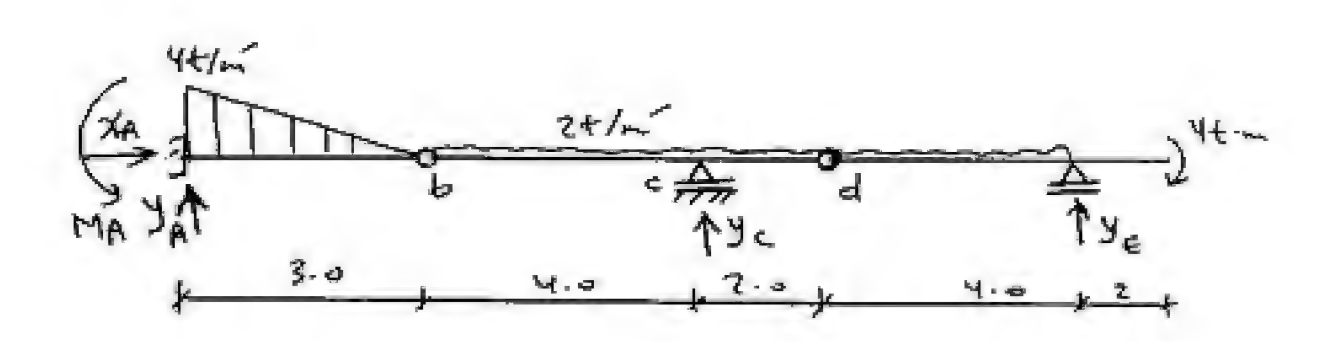
Problem ②



draw B.M.D, S.F.D, N.F.D

sol



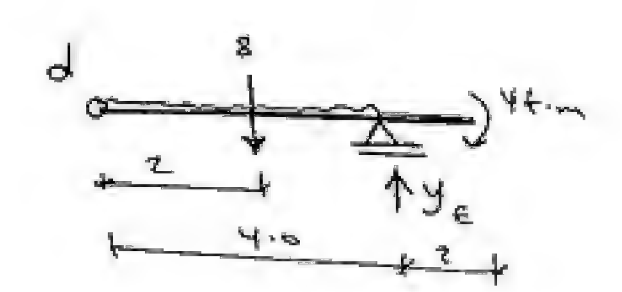


Reactions

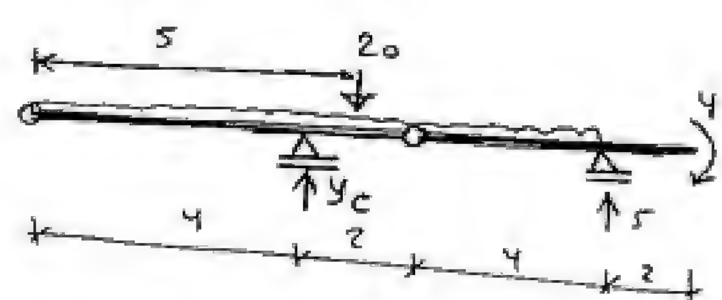
⇒ * $\sum M_{d_R} = 0.0$

$8 * 2 + 4 = y_E * 4$

$y_E = 5\ ton$



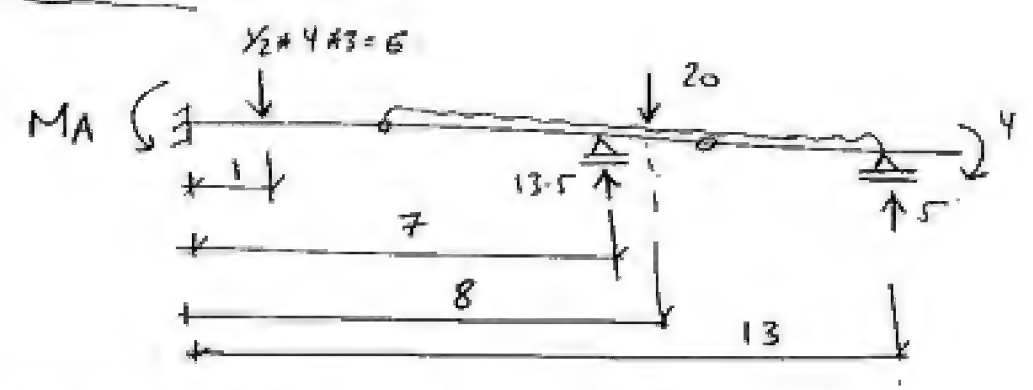
⇒ * $\sum M_{b_R} = 0.0$



$20 * 5 + 4 - 5 * 10 = y_c * 4$

⇒ $y_c = 13.5\ ton$

⇒ * $\sum M_A = 0.0$



$M_A = 6 * 1 + 20 * 8 + 4 - 13.5 * 7 - 5 * 13$

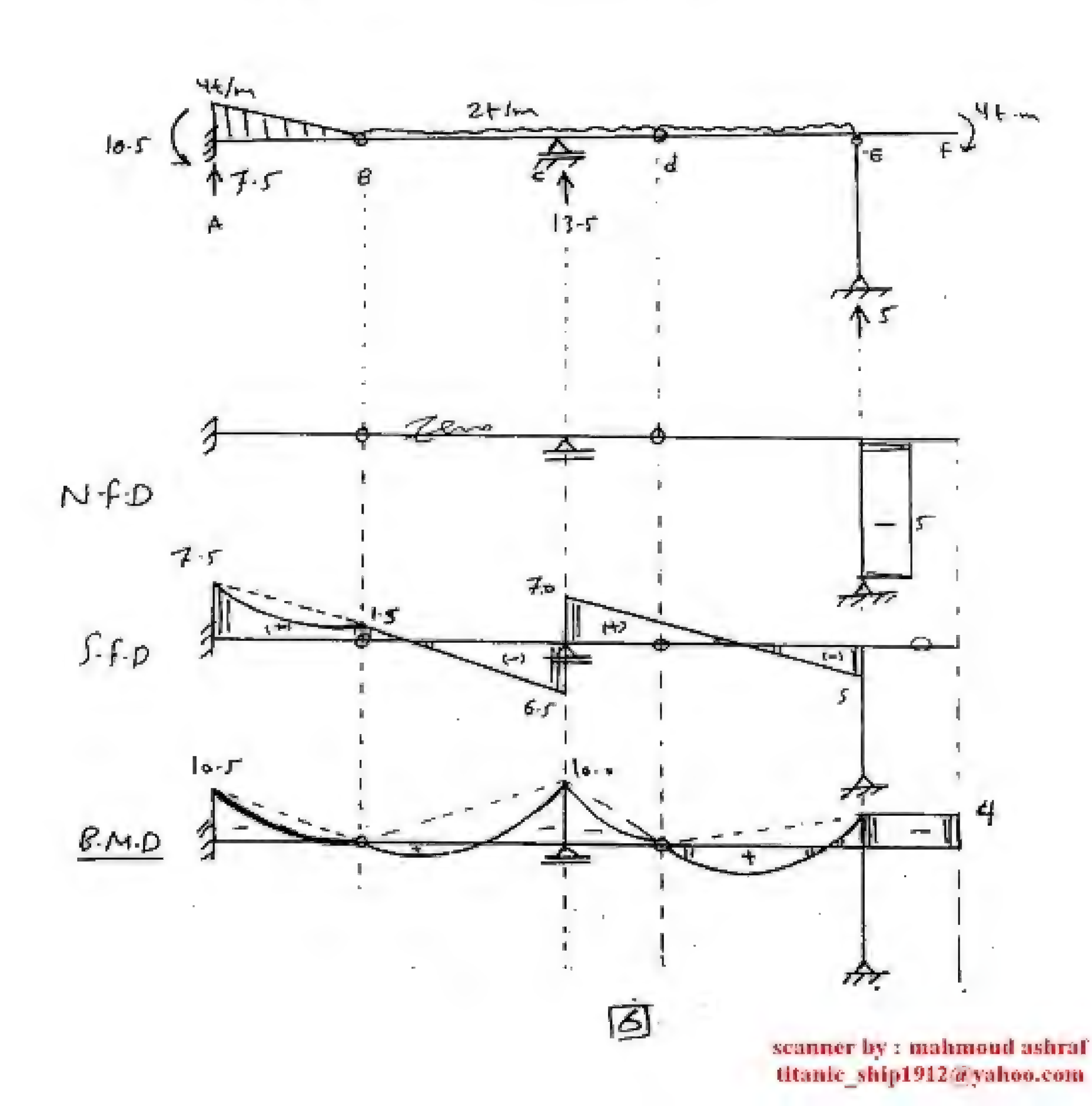
$= 10.5\ t.m$

$\Rightarrow \underline{\Sigma X = 0.0}$

$X_A = 0.0$

$\Rightarrow \underline{\Sigma y = 0.0}$

$y_A = 6 + 20 - 13.5 - 5 = 7.5 \text{ ton}$



الرسم S.F.D

نبدأ عند A

١- يوجد حمل (7.5) لأعلى نطلع بيه.

٢- من A ← B يوجد حمل مثلث يكون الـ shear فيه منحنى ويكون معلقة تحت الخط المائل لأنه متناقص.

وننزل من 7.5 قيمة الحمل (الموزع) = 6 t

$7.5 - 6 = 1.5$



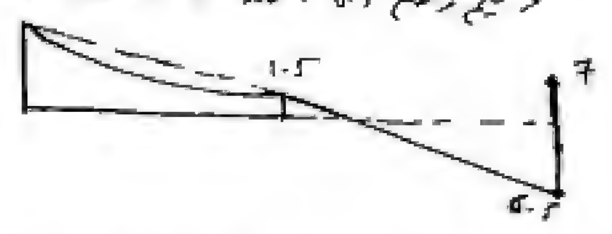
٣- من B ← C يوجد حمل موزع 2t/m

مقدار تركيزه = 2*4 = 8t

وبالتالي ننزل عند B ← C 8t

تحت ← 1.5 - 8 = -6.5 ∴

ويتم وضع -6.5 عند C وتوصيل B مع C بخط مائل.



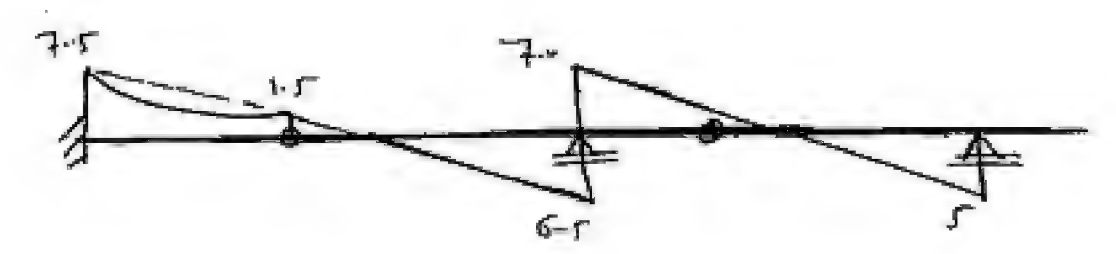
٤- عند C يوجد حمل لأعلى 17.5 ⇐ ∴ يتم الطلوع 13.5 من -6.5 تحت

فوق ∴ -6.5 + 13.5 = 7

2t/m
2 4
من ٥ ⟸ C E لا يوجد سوى الحمل الـ uniform
تركيزه = 2×6 = 12 لأسفل.

∴ $7-12=-5$

يتم رضع (5-) عند E وتوصيل من 5- ⟵ 7 بخط مائل.



٦- عند E يؤثر حمل 5t لأعلى ∴ يتم قفل الشكل.

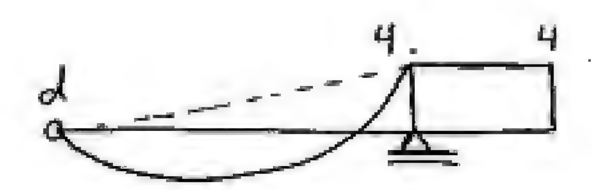
لرسم الـ B.M.D

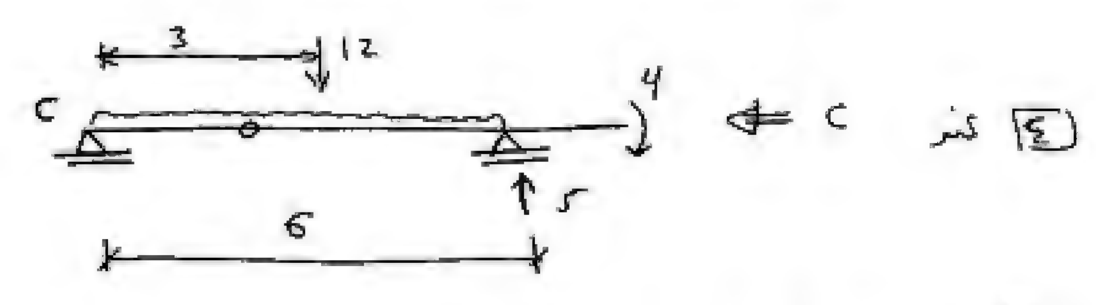
(1) عند F ⟸ عزم مركز منفرد 5t.m
∴ نبدأ بـ 4t.m منفرد.

(2) عند E ⟸ ناخذ العزم من اليمين
E —— 4t.m
∴ العزم يكون 4 منفرد أيضا.

٣ عند d ⟸ العزم = صفر Intermediate

يتم التوصيل 4 ⟸ 0 بخط منقط وتعليه Parabola





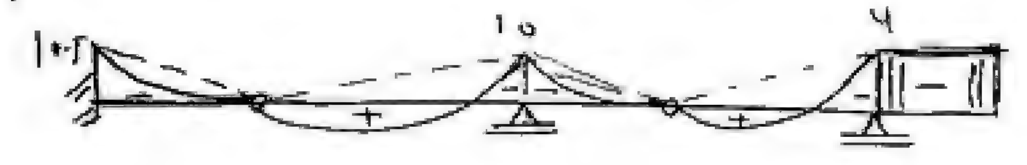
٤ عند C ⟸

موجبة $M_c = 12*3+4-5*6 = 10 \ t.m$

يتم التوصيل بين 0 ⟵ 10 بخط منقط وتعليه Parapolal



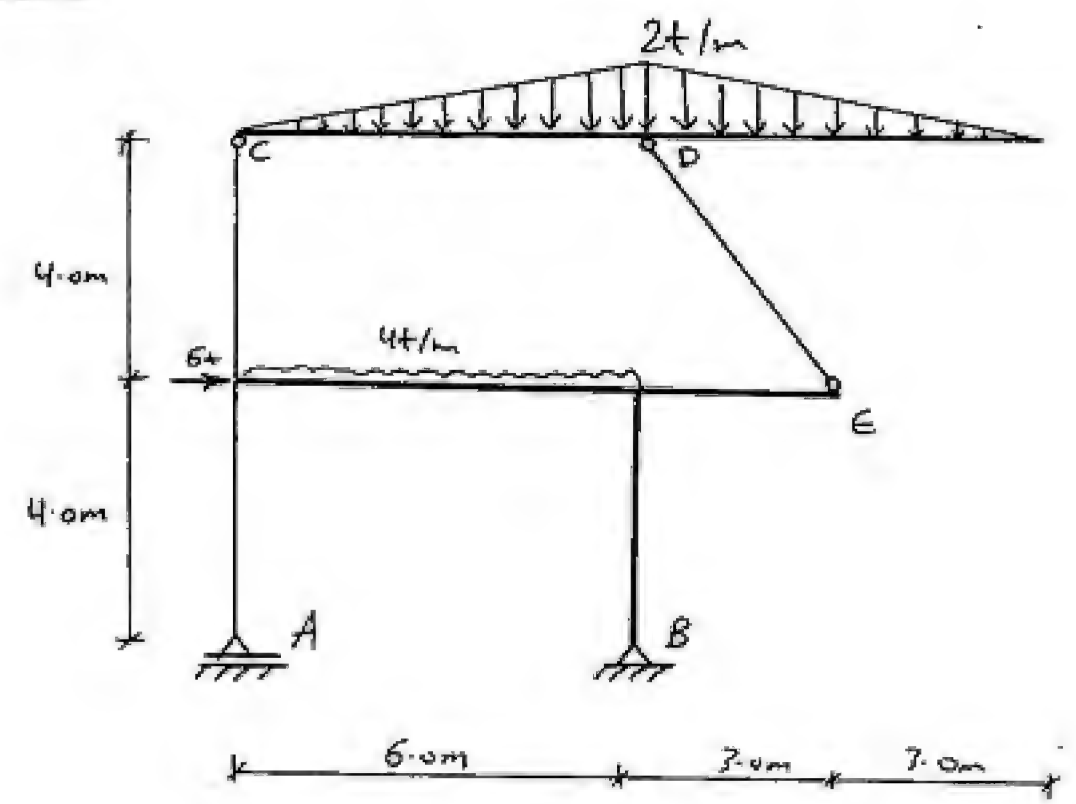
٥ عند B العزم = صفر يتم التوصيل بين 10 ⟵ 0 بخط منقط وتعليه Parapola



٦ عند A العزم محسوب كـ Reaction = 10.5 موجبة يتم

التوصيل بـ 0 ⟵ 10.5 بخط منقط وتعليه Parapola

Prob (3)

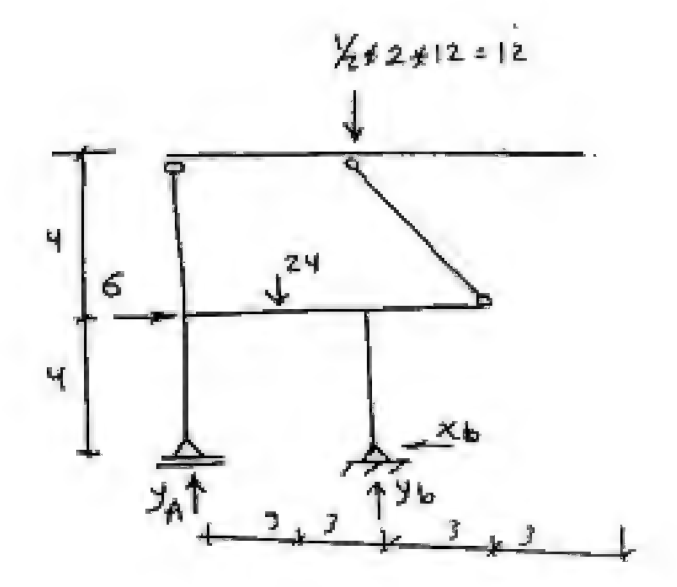


for the following frame draw

N.F.D, S.F.D, M.D

— J.2 —

For Reaction



$\Rightarrow \sum X = 0.0$

$X_b = 6 \text{ ton}$

$\Rightarrow M_A = 0.0$

$$6*4 + 24*3 + 12*6 = y_b*6$$

$$y_b = 28 \text{ ton.}$$

$\Rightarrow y = 0.0$

$$y_a = 12 + 24 - 28 = 8 \text{ ton}$$

↓12

C

θ

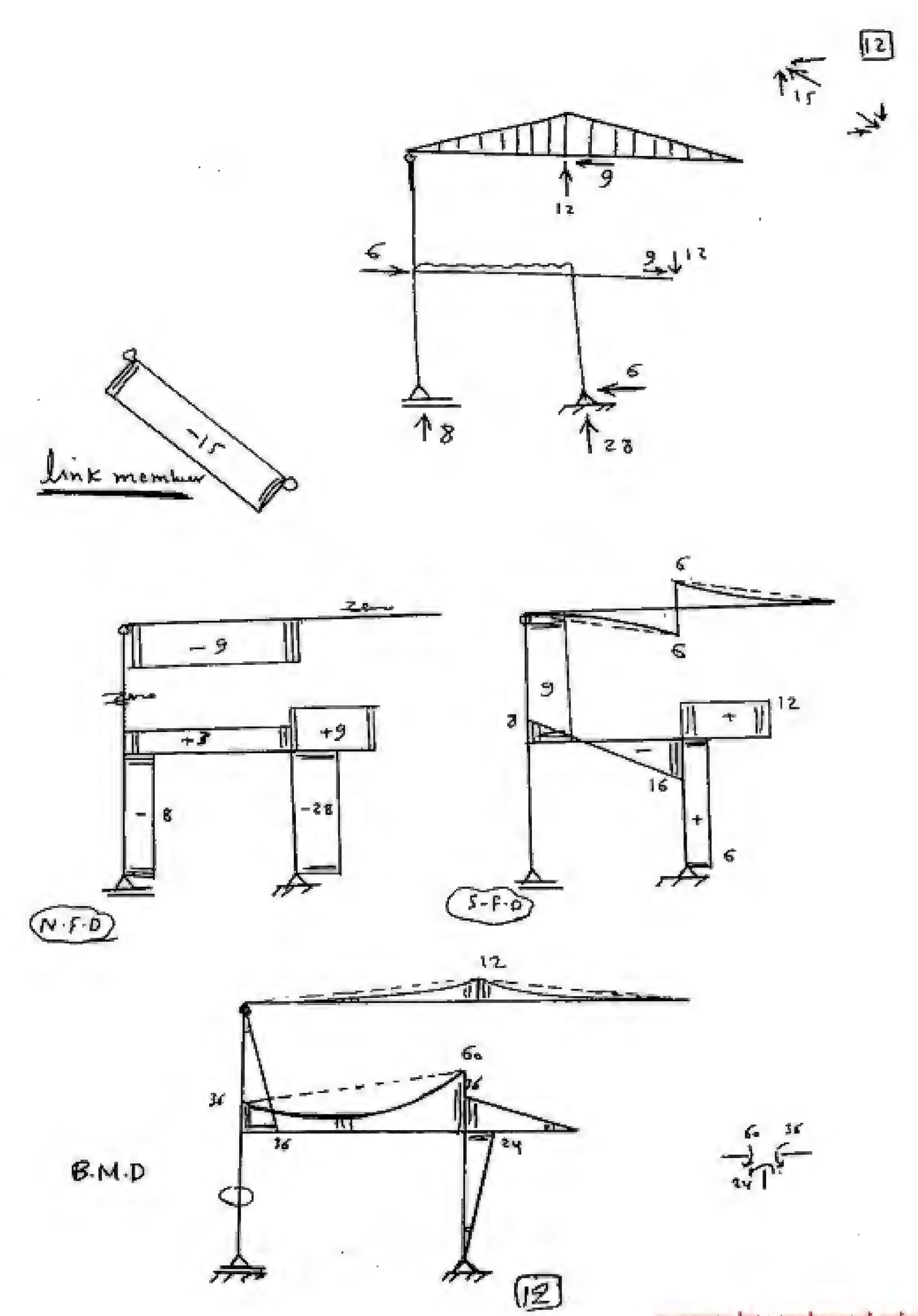
F

$F \sin\theta = 0.8F$

$\sum M_{C_R} = 0.0$

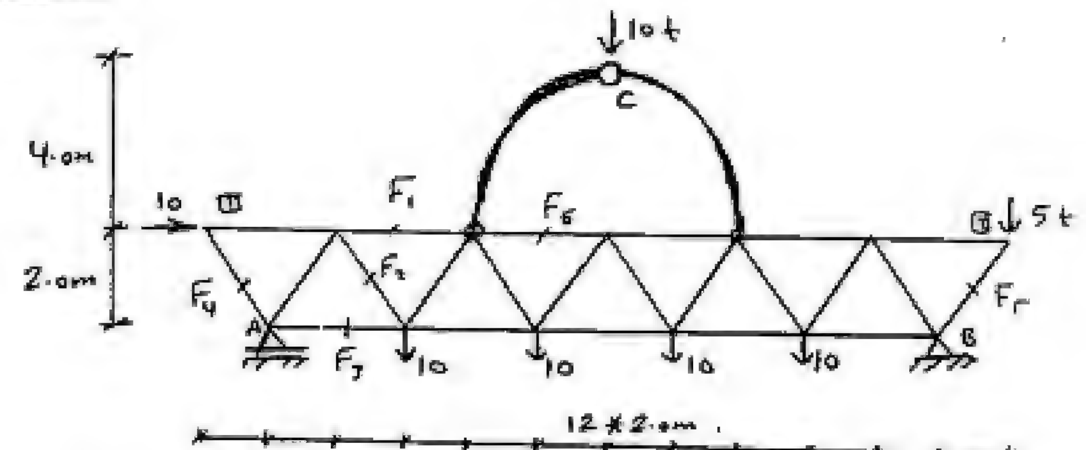
$$12*6 = 0.8F*6$$

$$F = 15 \text{ ton}$$



15
9
12
6
9
12
6
8
28
-15
link member
zero
-9
zero
+3
+9
-8
-28
N.F.D
6
6
9
3
12
+
16
+
6
S.F.D
12
60
36
36
36
24
B.M.D

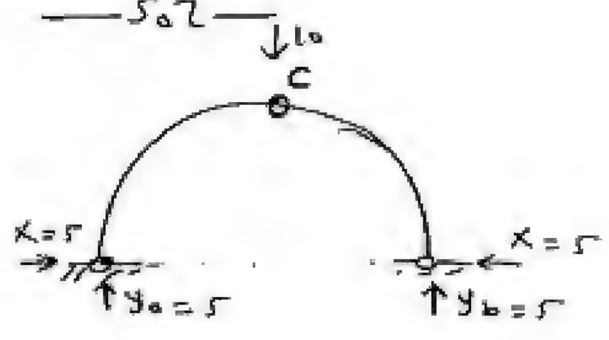




Find the Internal forces
In the marked member

— Sol —

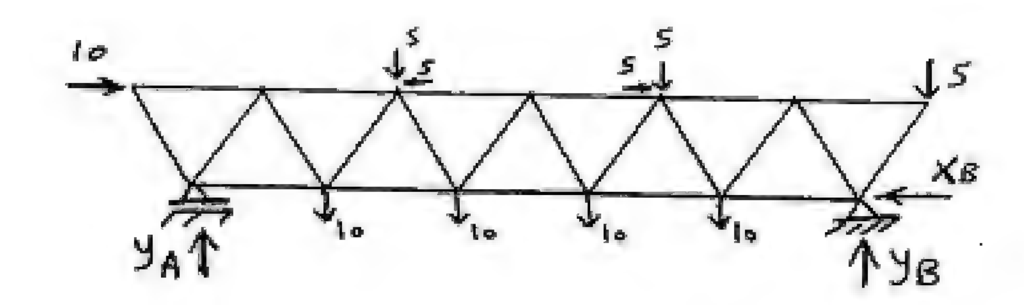
Arch Reactions تنتقل
truss للـ



$\Sigma M_{cR} = 0.0$

$5 * 4 = X * 4$

$X = 5$ ton



* $\underline{\Sigma X = 0.0}$

$X_B = 10 \text{ ton}.$

* $\underline{\Sigma M_A = 0.0}$

$$10*2 + 10*4 + 10*8 + 10*12 + 10*16 + 5*22 + 5*6 + 5*14 = y_B * 20$$

$$\Rightarrow y_B = 31.5 \text{ ton}.$$

* $\underline{\Sigma y = 0.0}$

$y_A = 23.5$

Forces

joint (1)

Zero $F_4 = 0.0$

joint (2)

$\Sigma y = 0.0$

$5 = F_5 \cdot \sin\theta$

$F_5 = 5/\sin 45 = 7.07$ ton (ضغط)

Sec I

$\Rightarrow \sum F_y = 0.0$

$$F_2 \sin\theta = 23.5$$

$$F_2 = 23.5/\sin 45 = 33.23 \text{ ton} \quad (\text{شد})$$

$\Rightarrow \sum M_3 = 0.0$

$$23.5 * 2 = F_3 * 2$$

$$F_3 = 23.5 \text{ ton} \quad (\text{شد})$$

$\Rightarrow \sum M_4 = 0.0$

$$10 * 2 + 23.5 * 4 + F_1 * 2 = 0.0$$

$$F_1 = -57 \text{ ton} \quad (\text{ضغط})$$

Sec II

$\sum M_5 = 0.0$

$$10*2 + 23.5*8 - 10*4 - 5*2 - 5*2 + F_6*2 = 0.0$$

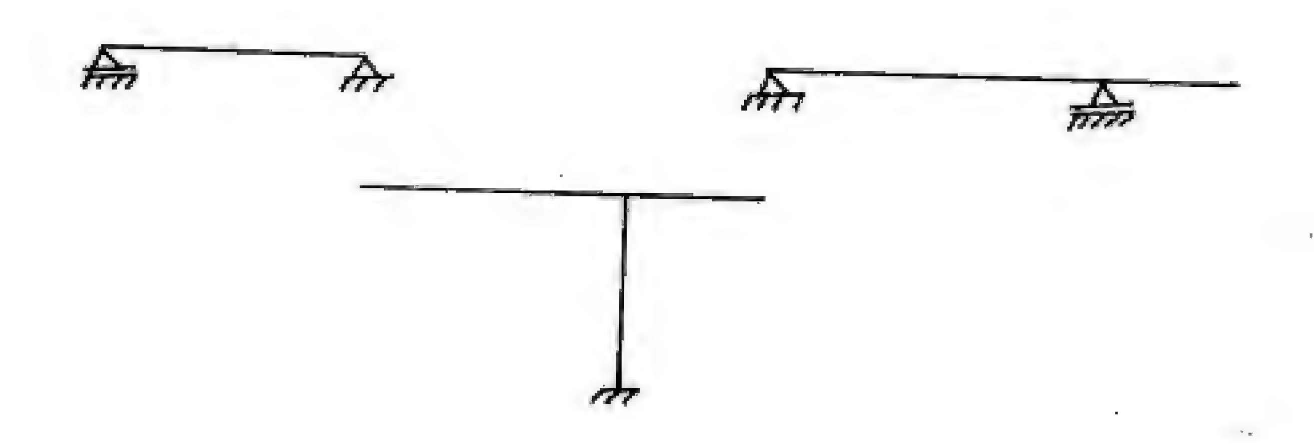
$$\therefore \quad F_6 = -74 \text{ ton} \quad (\text{ضغط})$$

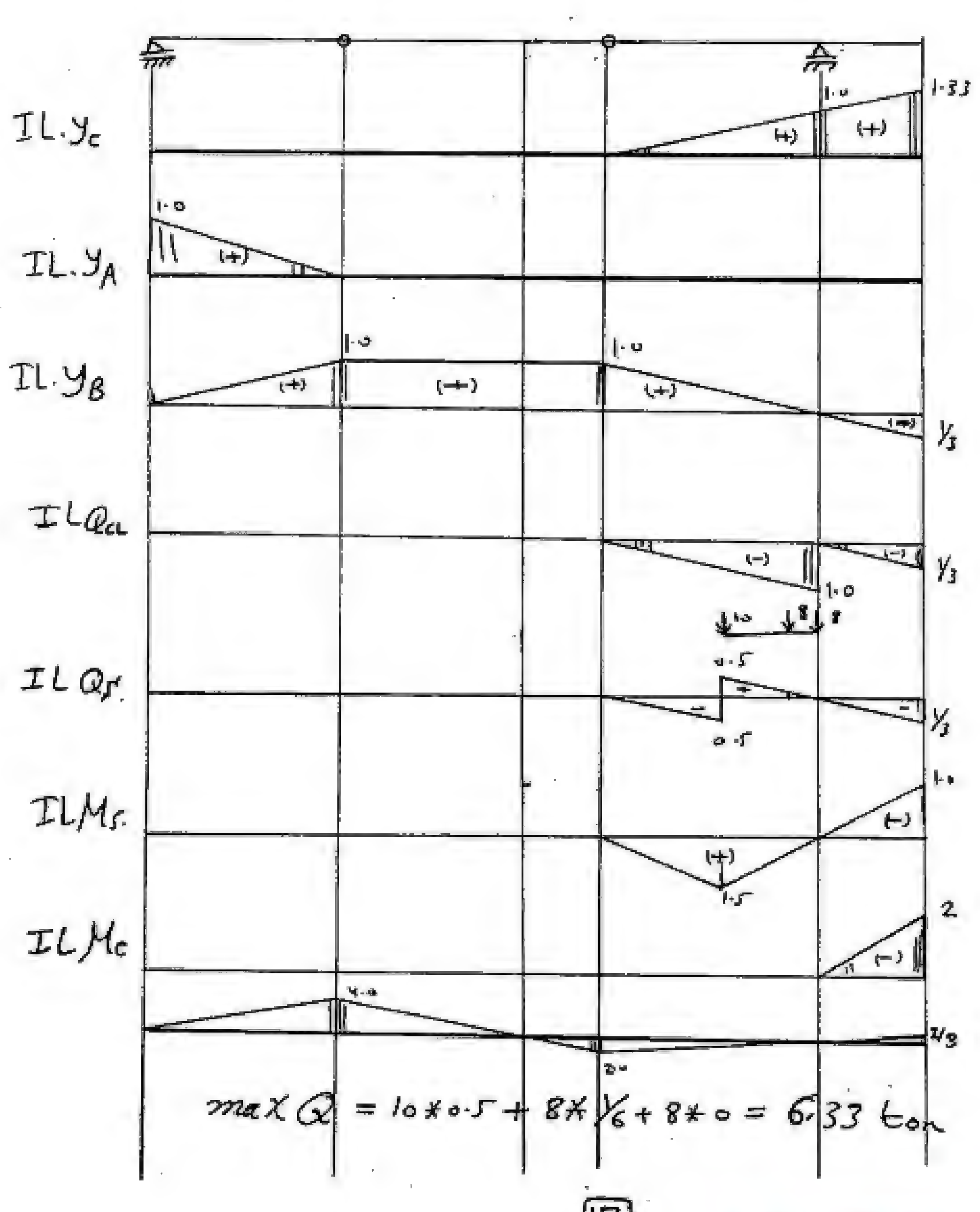
Prob(5)

(i) draw the influnce lines of Y_a, Y_b, Y_c, Q_{c_L}, M_B, M_c, Q_s and M_s

(ii) determine the max Q_s due to the given Loading system.

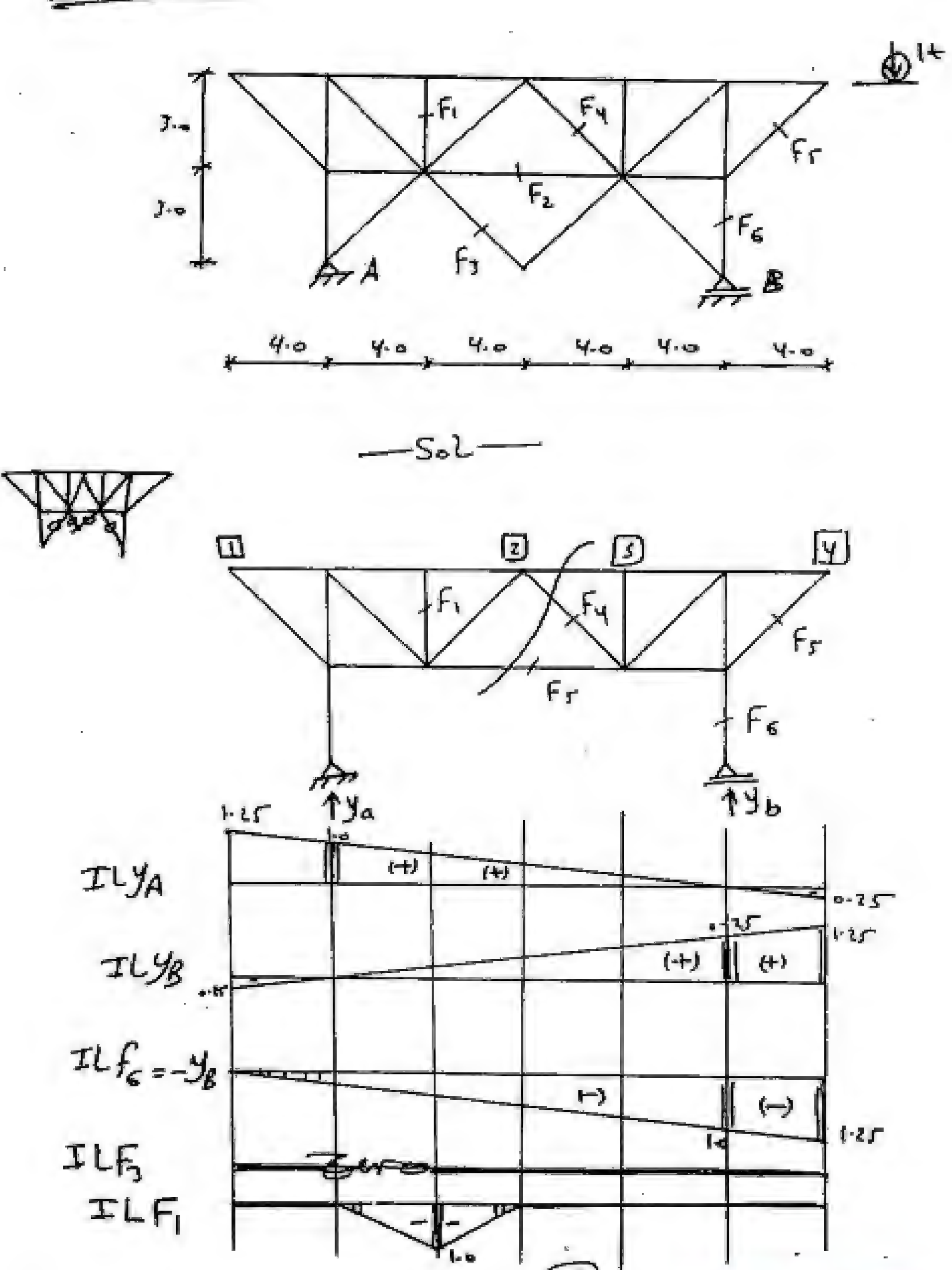
— Sol —



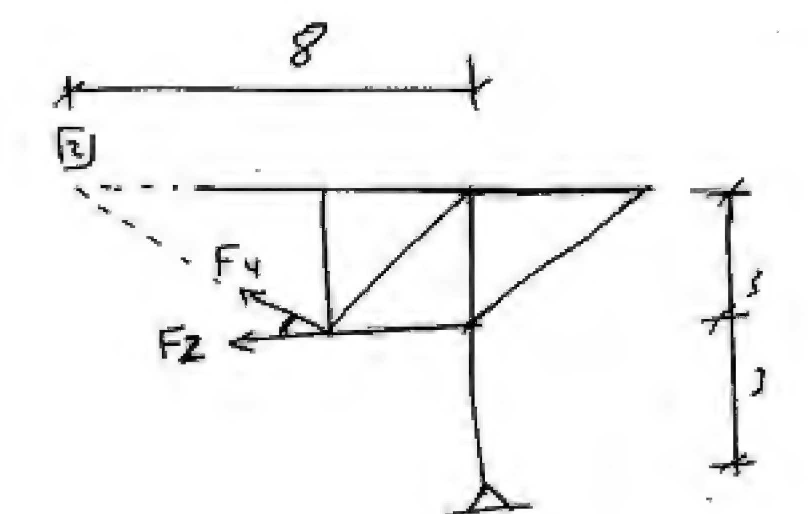


$max\ Q = 10 * 0.5 + 8 * \frac{1}{6} + 8 * 0 = 6.33$ ton

final 2007


1t
3.0
3.0
F1
F4
F5
F2
F6
F3
A
B
4.0
4.0
4.0
4.0
4.0
4.0
Sol
1
2
3
4
F1
F4
F5
F5
F6
ya
yb
1.25
1.0
ILyA
(+)
(+)
0.25
ILyB
0.25
1.25
(+)
(+)
0.25
ILf6 = -yB
(-)
(-)
1.0
1.25
ILF3
Zero
ILF1
-
-
1.0





$\Rightarrow \Sigma M_2 = 0.0$

$8 y_b = 3 F_5$

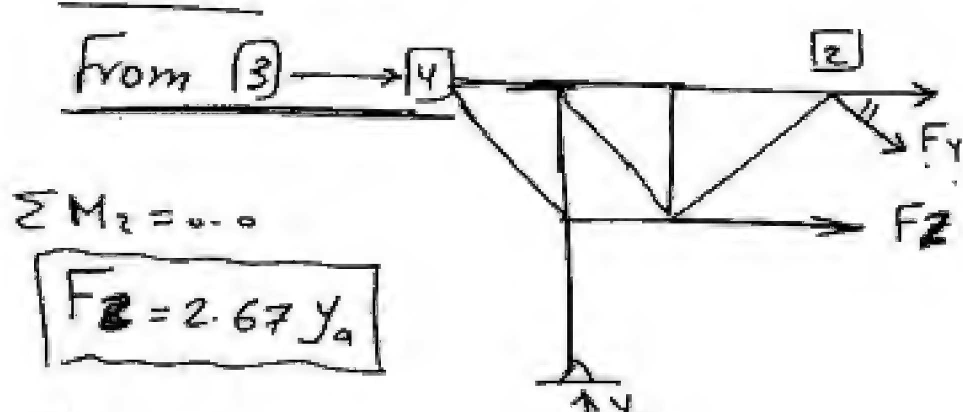
$\boxed{F_Z = 2.67\, y_b}$

$\Rightarrow \Sigma y = 0.0$

$F_4 = -\dfrac{y_b}{0.6} = -1.67\, y_b$

$\boxed{F_4 = -1.67\, y_b}$

From 3 → 4



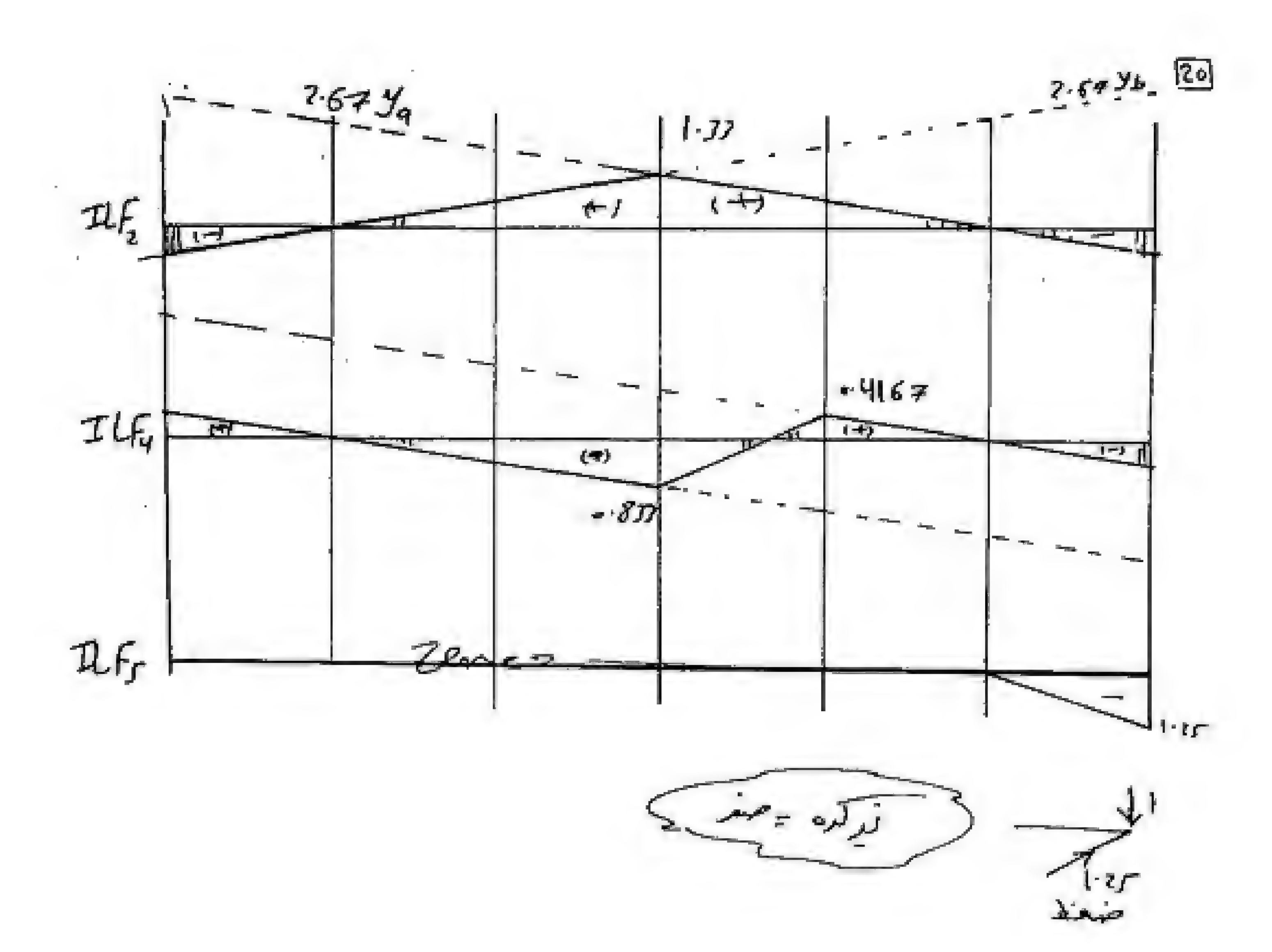
$\Sigma M_2 = 0.0$

$\boxed{F_Z = 2.67\, y_a}$

$\Sigma y = 0.0$

$0.6\, F_4 = y_a$

$\boxed{F_4 = 1.67\, y_a}$



2.67 y_a
2.67 y_b
1.33
ILF2
ILF4
.4167
.833
ILF5
Zero
1.25

Zagazig University
Faculty of Engineering
1st Year Civil Eng.
Full Marks: 90 Marks

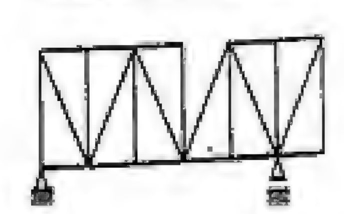
Assume Any Missing Data

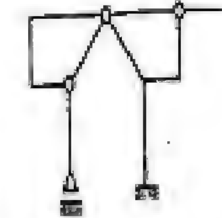
Structural Analysis
Final Term Examination
Date: 18/1/ 2006.
Time Allowed: 3 Hours

Attempt All problems:

PROBLEM NO. (1): (20 MARK)

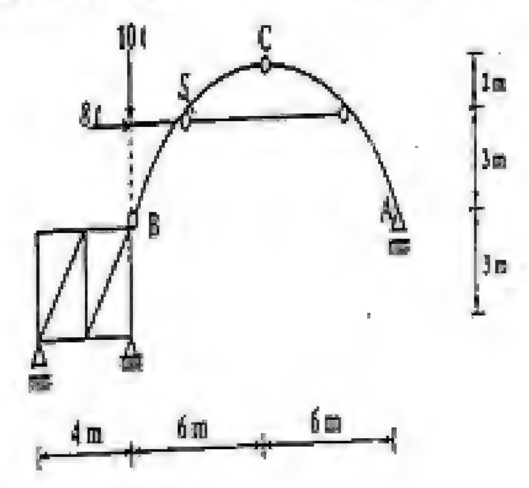
a) Check the stability and determinacy for the given structures. If they are unstable or statically indeterminate, show how they can be modified to become stable and determinate.





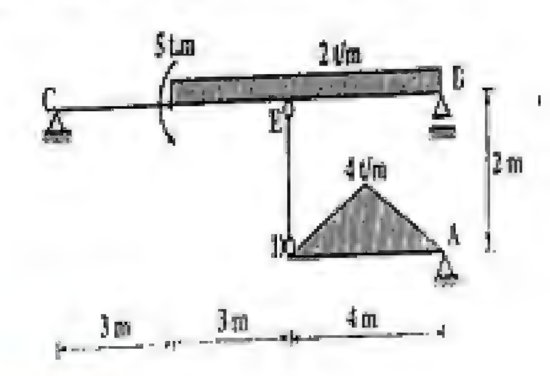
b) Calculate the N.F., S.F. and B.M. at section (S) in the given parabolic arch:





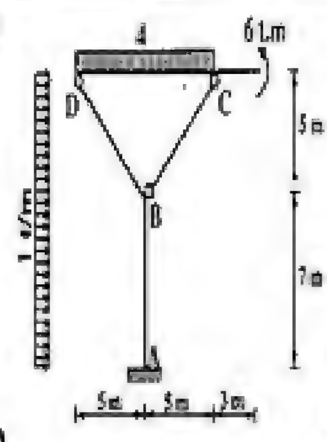
PROBLEM NO. (2): (16 MARK)

Draw the N.F., S.F. and B.M. Diagrams for the given Beam:



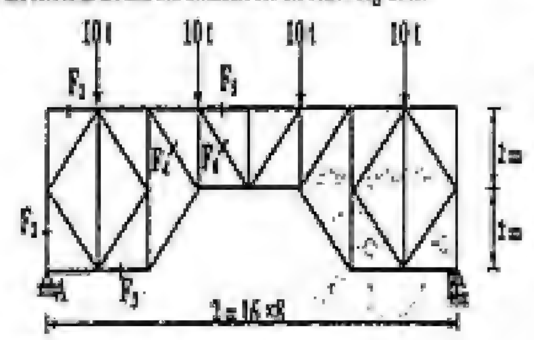
PROBLEM NO. (3): (16 MARK)

Draw the N.F.S.F. and B.M.Ds. for the given Frame:



PROBLEM NO. (4): (12 MARKS)

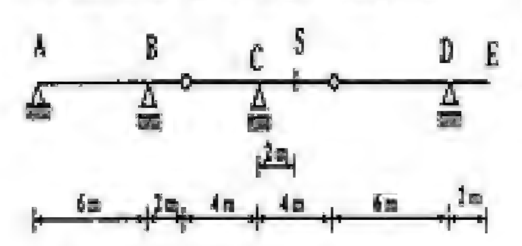
Fined the forces in the marked members for the following truss:



PROBLEM NO. (5): (20 MARKS)

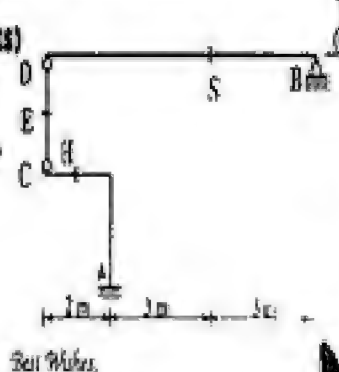
a) Draw the influence lines of Y_A, Y_B, Y_C, Y_D, Q_{Br}, Q_{Bl}, M_B, Q_S and M_S for the Shown Beam:

b) Determine the max. Q_S due to the given loading system:



PROBLEM NO. (6): (16 MARKS)

Draw the influence lines of Y_A, Y_B, Y_D, M_A, Q_S, M_S, N_E, Q_H for the Shown Frame:



Best Wishes,
Prof. Dr. Ashraf M. El-Shahy
Prof. Dr. Hesham S. Shaaban *Dr. Tarek M. Amer*

a) check the stability

the given structure.	state	modification.
1)	unstable 4 → معادلات 3 → مجاهيل.	
2) A B c d	unstable AB & cd ↳ unstable	بعد تصليح الشكل ليكون stable كل جزء مقفول به (٣) مجاهيل نتيج رسم Int -

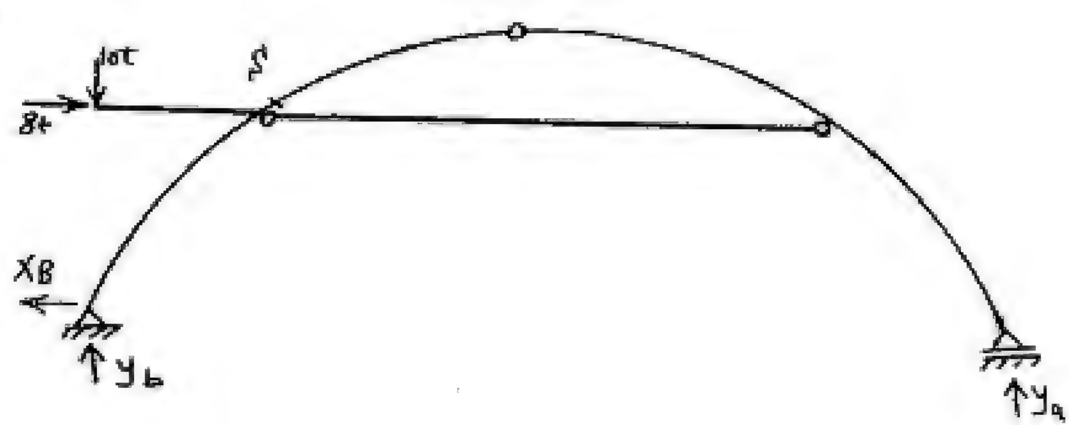
b)

10t, 8t, C, B, A

2.0, 3.0, 3.0

2, 2, 6.0, 6.0





$\Sigma M_b = 0.0$

$$8 * 3 = y_a * 12$$

$$y_a = 2 \text{ ton}$$

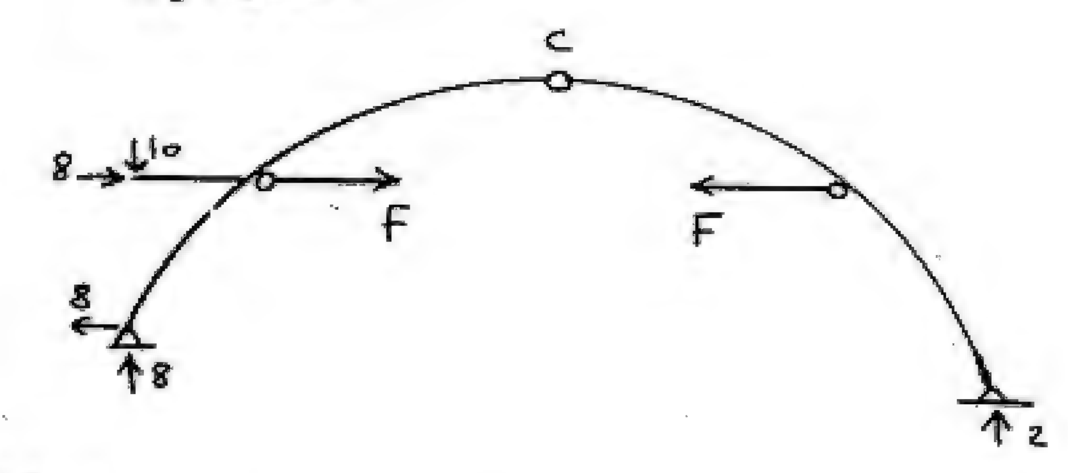
$\Sigma y = 0.0$

$$y_b + 2 = 10$$

$$y_b = 8 \text{ ton}$$

$\Sigma x = 0.0$

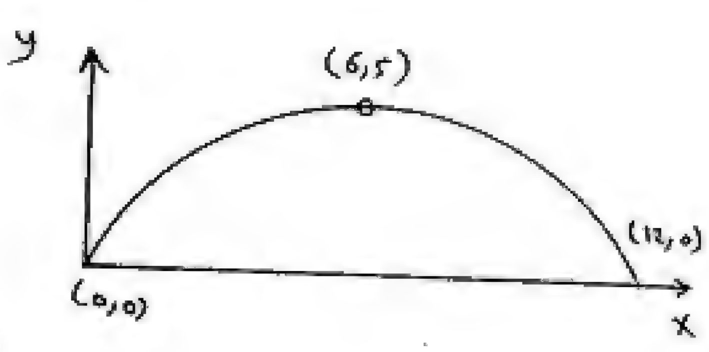
$$x_b = 8 \text{ ton}$$



$\Sigma M_{c_R} = 0.0$

$$2 * 6 = 2F \Rightarrow F = 6 \text{ ton.}$$

For eqn of Parapolic Arch



$$y = a x^2 + b x + c$$

⇒ at $x = 0.0$, $y = 0.0$

$$0 = 0 + 0 + c \Rightarrow c = 0.0$$

⇒ at $x = 12$, $y = 0.0$

$$0.0 = a(12)^2 + b(12)$$

$$\Rightarrow b = -12a$$

⇒ at $x = 6$, $y = 5$

$$5 = a(6)^2 + (-12a)(6)$$

$$a = -\frac{1}{7.2}$$

$$\therefore b = 1.67$$

$$\therefore \boxed{y = -\frac{X^2}{7.2} + 1.667\,X}$$

at $S' \Rightarrow \quad y = 3$

$$\Rightarrow 3 = -\frac{X^2}{7.2} + 1.667\,X$$

$$-X^2 + 12\,X = 21.6$$

$$\therefore \boxed{X = 2.2}$$

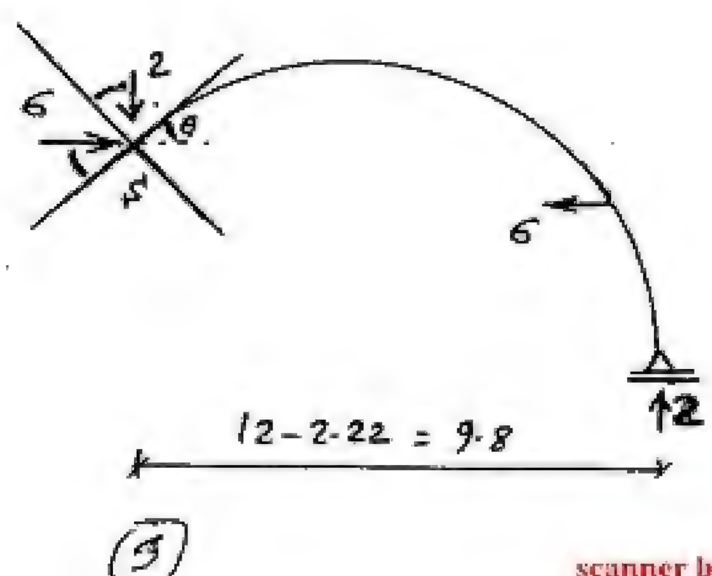
$$y' = -\frac{2X}{7.2} + 1.667$$

$$y' = \tan\theta = -\frac{2(2.2)}{7.2} + 1.667 = -1.055$$

$$\therefore \theta = -46.54$$

$$\cos\theta = 0.687$$

$$\sin\theta = +0.7258$$

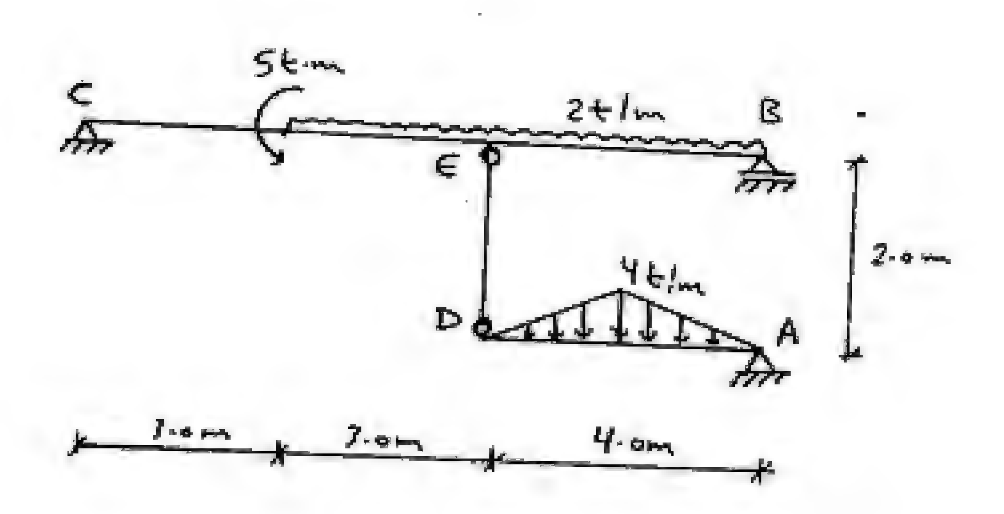


$N_5 = 2\sin\theta - 6\cos\theta = -2.67$ ton.

$Q_5 = -2\cos\theta - 6\sin\theta = -5.73$ ton.

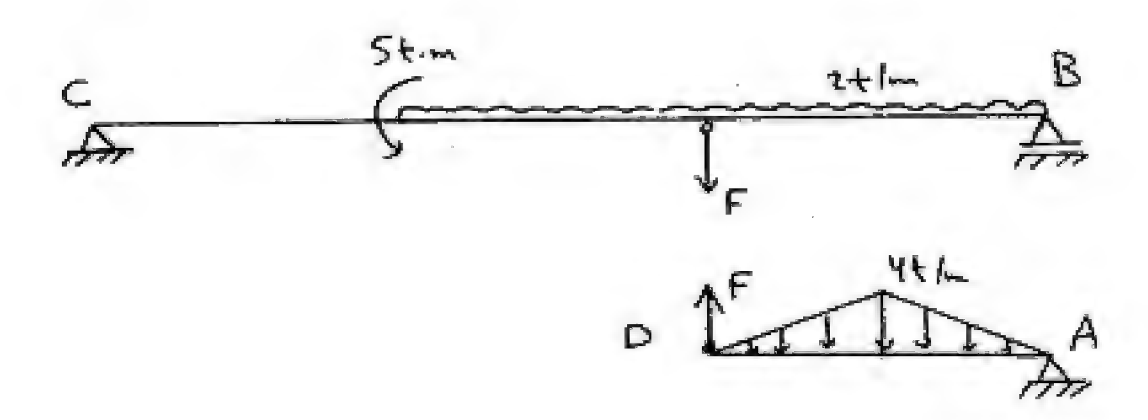
$M_5 = 2 \times 9.8 - 6 \times 0 = 19.6$ t.m

Prob (2)



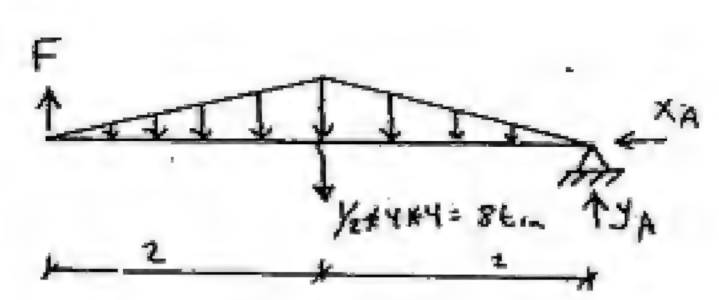
draw N.F.D , S.F.D , B.M.D

For the following beam.



يعتبر اصبحت كل جزء مسأله لوحدها، التجميع فقط.

Part A – D



$\Sigma X = 0.0$

$$\boxed{X_A = 0.0}$$

$\Sigma M_A = 0.0$

$$8 * 2 = F * 4$$

$$\boxed{F = 4 \text{ ton}}$$

$\Sigma Y = 0.0$

$$4 + Y_A = 8 \Rightarrow \boxed{Y_A = 4 \text{ ton}}$$

4t/m

4t

4t

N.F.D

S.F.D

4 (+) (−) 4

B.M.D

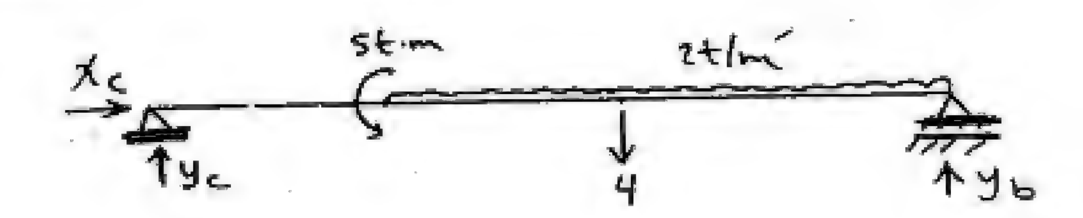
(+)

5.33

$\frac{1}{3}(2)$

$$M = 4 * 2 - 4 * \frac{2}{3}$$
$$= 8 - \frac{8}{3} = 5.33$$

Par C − B



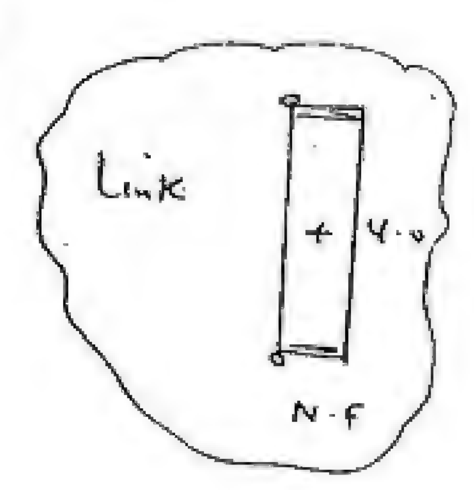
$$\Sigma X = 0.0$$

$$X_c = 0.0$$

$$\underline{\Sigma M_c = 0.0}$$

$$4 * 6 + (2 * 7)(3 + 3.5) = 5 + 10 * y_b$$

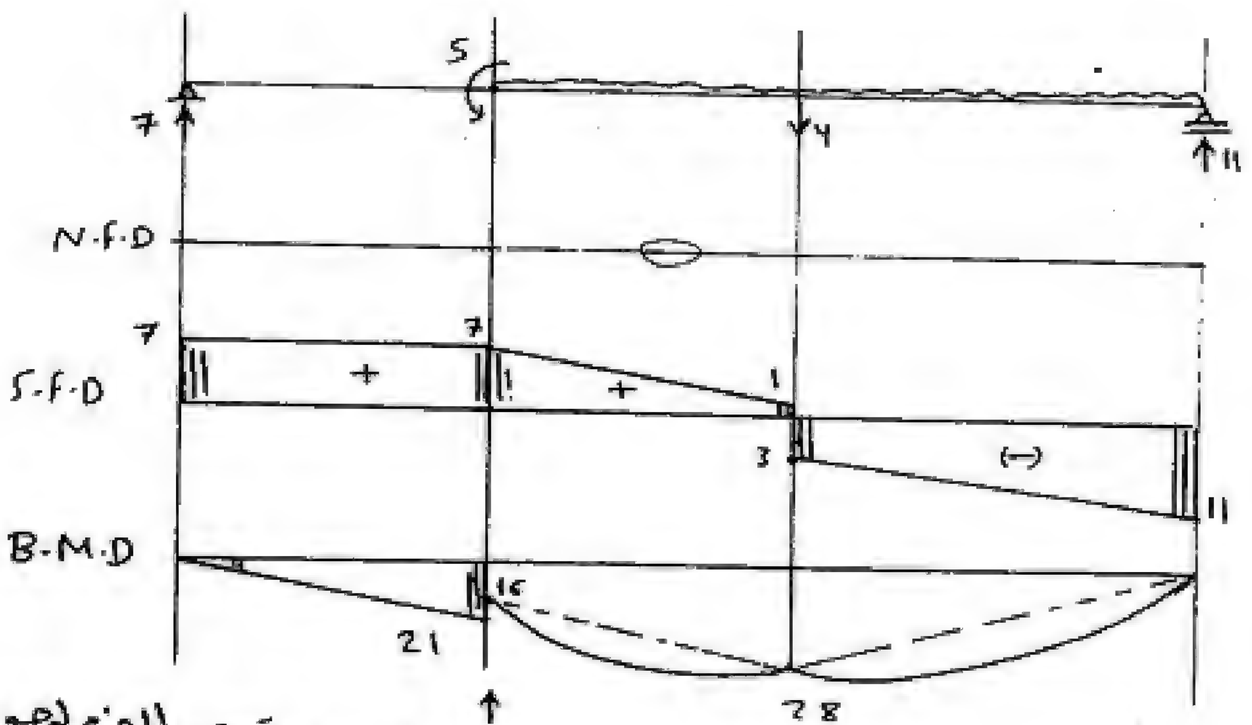
$$\therefore \boxed{y_b = 11 \text{ ton}}$$



$$\underline{\Sigma y = 0.0}$$

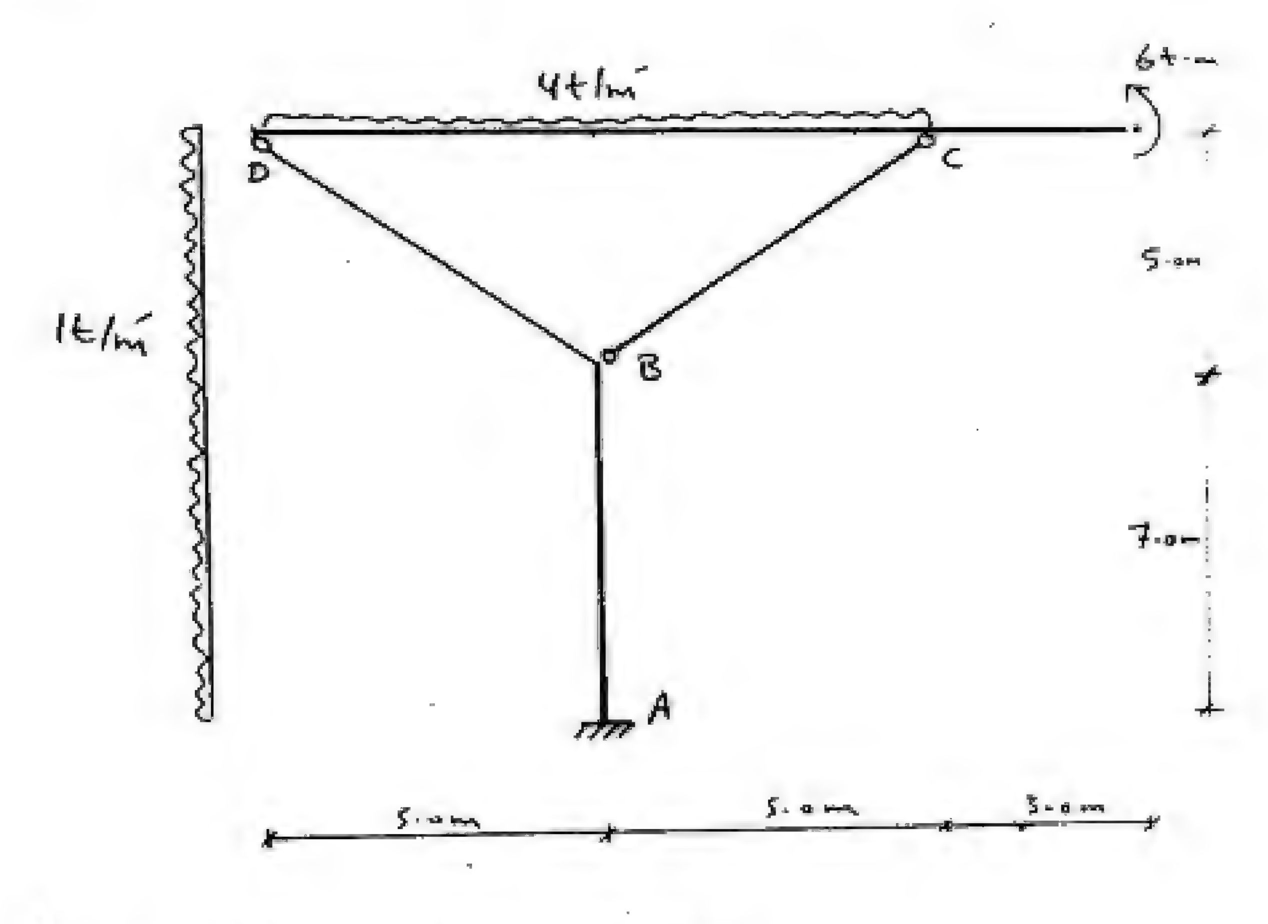
$$y_c + 11 = 14 + 4$$

$$\boxed{y_c = 7 \text{ ton}}$$



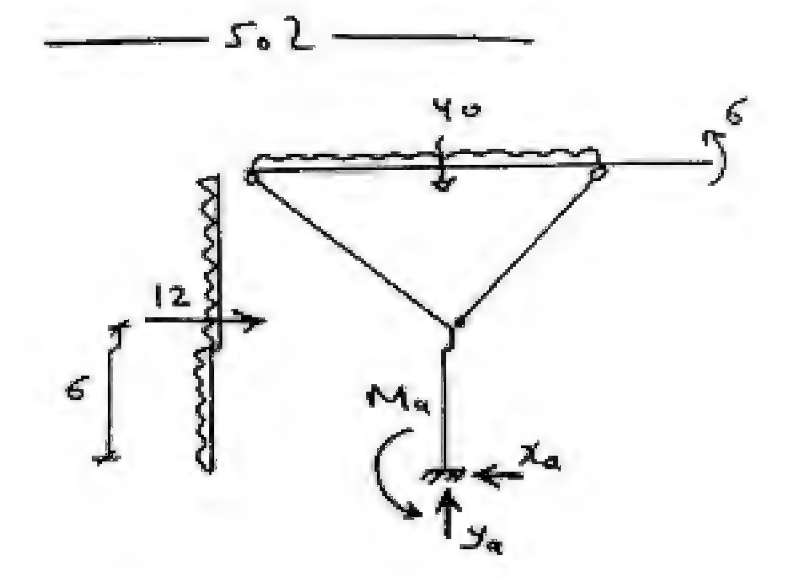
في هذا المكان يوجد قيمتين للعزم لوجود
العزم المركز فنعمل كسرة عند العزم وشماله
ثم نحسب من الشمال مرة قبل ومرة بعد العزم.

Prob3



draw N.F.D , S.F.D , B.M.D

Sol



$\Sigma X = 0.0$

$$X_a = 12 \text{ ton}$$

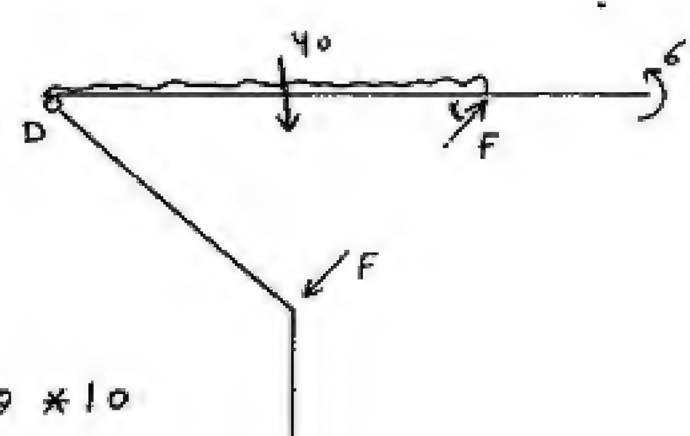
$\Sigma Y = 0.0$

$$Y_a = 40 \text{ ton}$$

$\Sigma M_A = 0.0$

$$12 * 6 + 40 * 0 = 6 + M_a$$

$$M_a = 66 \text{ t.m}$$

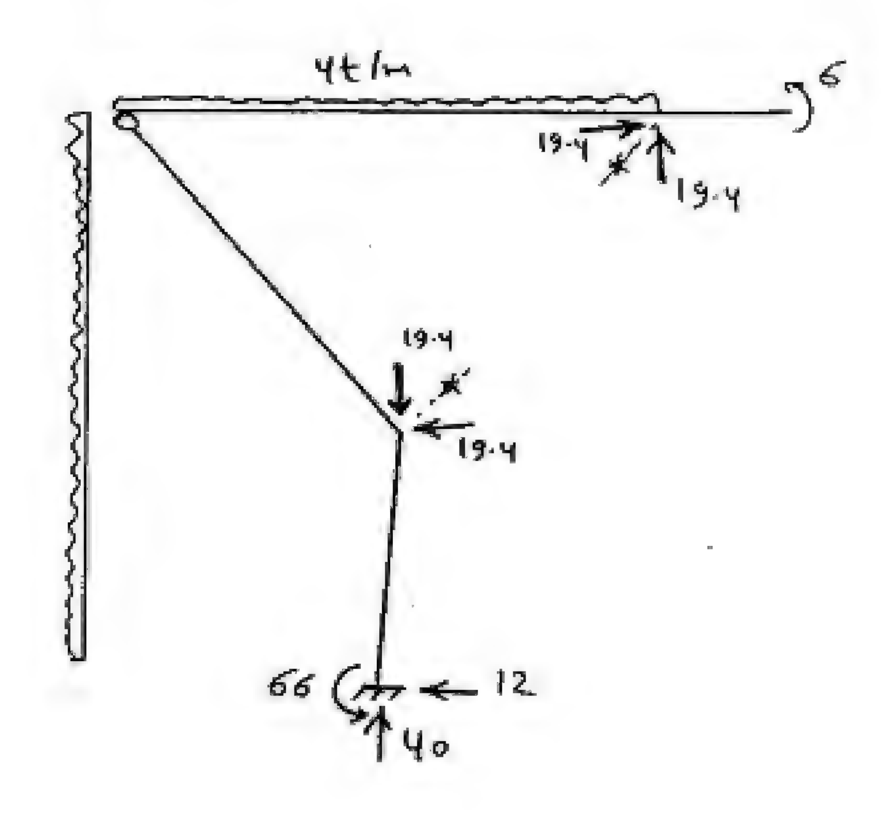


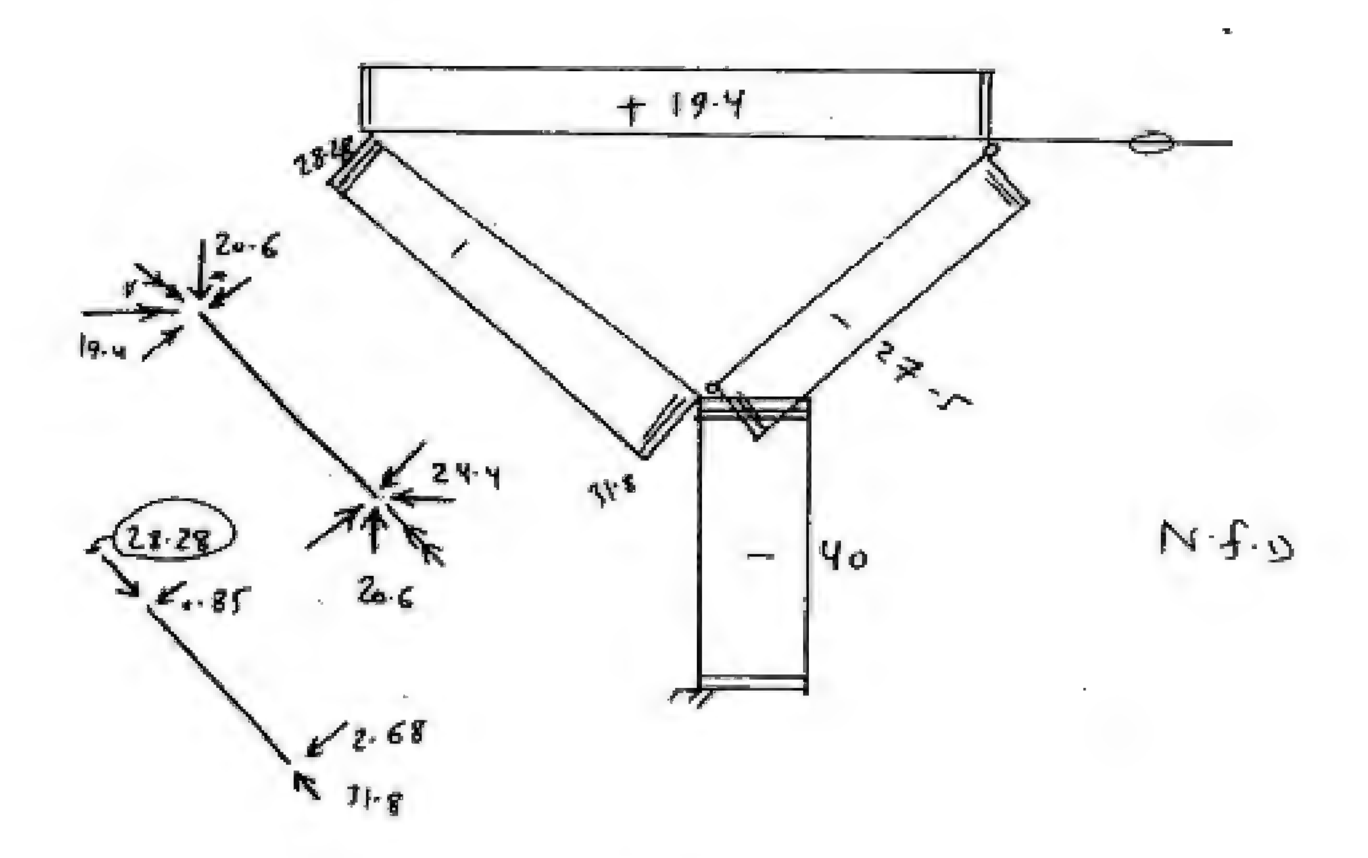
$\Sigma M_{DR} = 0.0$

$$40 * 5 - 6 = F \sin\theta * 10$$

$$\sin\theta = 0.707$$

$$F = 27.5 \text{ ton}$$


4t/m
6
19.4
19.4
19.4
19.4
66
12
40


+ 19.4
28.28
20.6
19.4
24.4
20.6
28.28
2.68
31.8
27.5
40
N.f.D

4.6

0.85

19.4

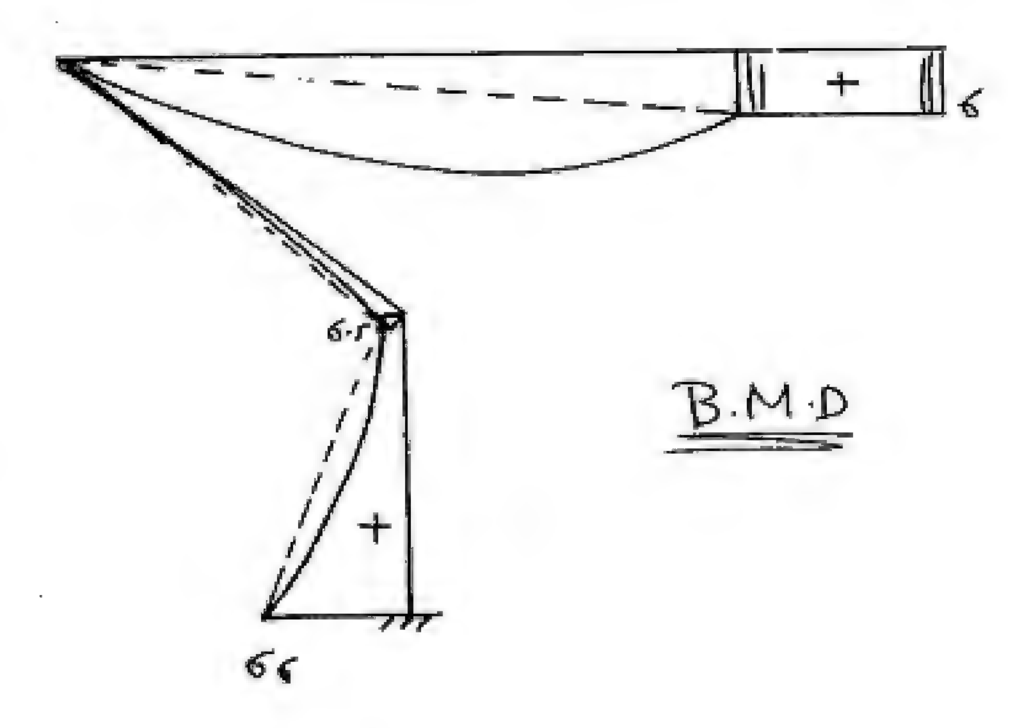
2.68

5

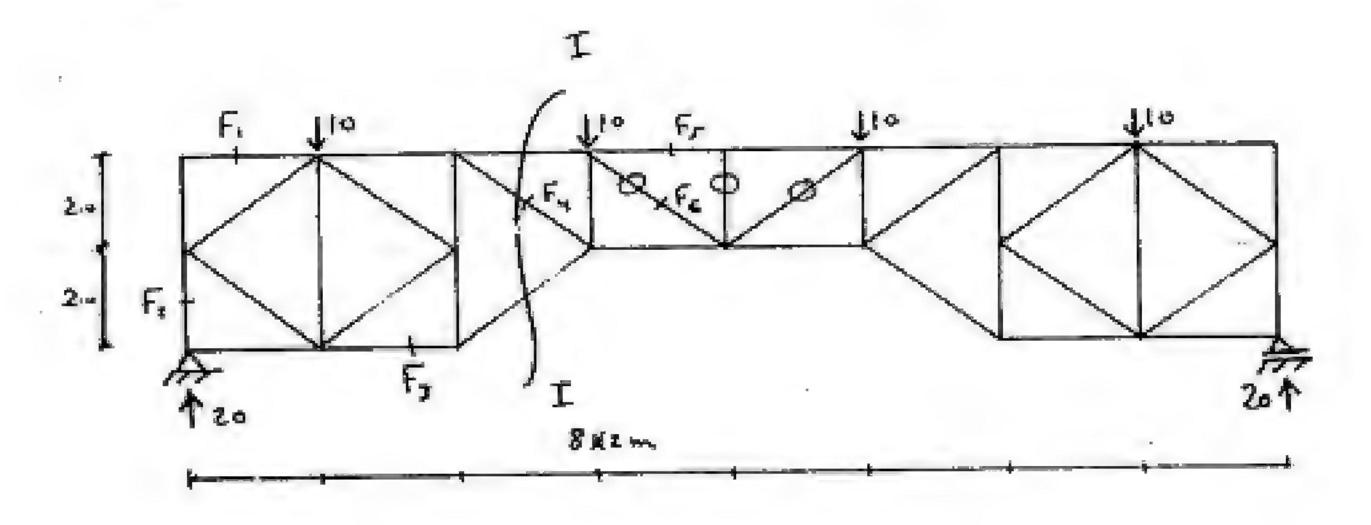
12

S.F.D

لاحظ أن الـ shear
الأجزاء الرأسيه
وأنه قد يختلف
واحد من آخر في الاتجاه
والمحور واحد



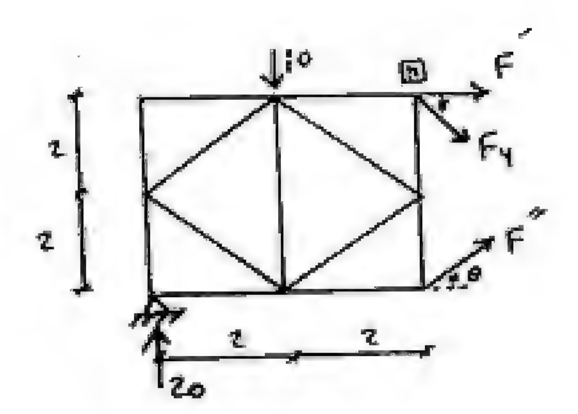
Prob(4)



— Sol —

$F_1 = 0$

$F_2 = -20$



$\rightarrow \underline{\Sigma M_n = 0.0}$

$$20 * 4 = 10 * 2 + F''(0.707) * 4$$

$$F'' = 21.21$$

$\Sigma x = 0.0$

$$F_4 \cos 45 + 21.21 \cos 45 + F' = 0.0$$

$$\boxed{F_4 + 1.414 F' = -21.21}$$

$\Sigma y = 0.0$

$$20 + 21.21 \sin 45 = 10 + F_4 \sin 45$$

$$\boxed{F_4 = 35.35}$$

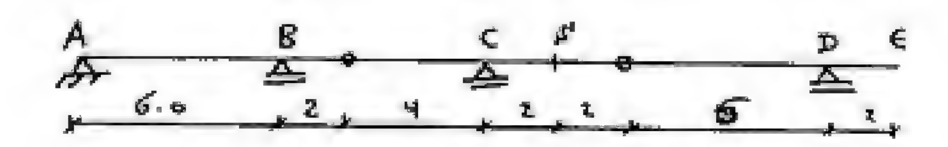
$$\therefore \boxed{F' = -40}$$

$$F_3 = F'' \cos 45 = 21.21 \cos 45 = \boxed{15 \text{ ton}}$$

$$\boxed{F' = F_5 = -40}$$

$$\boxed{F_6 = 0.0}$$

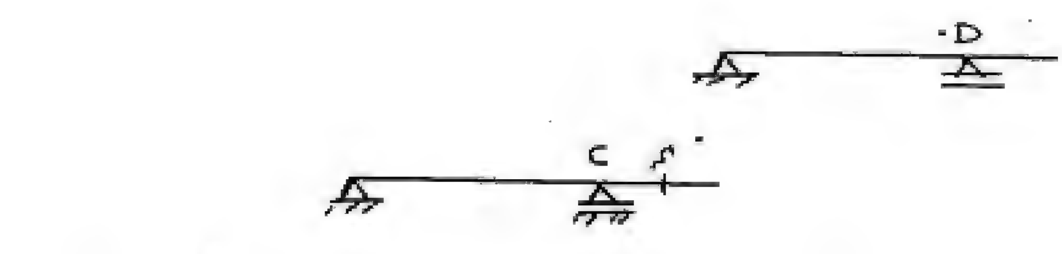
Prob (5)

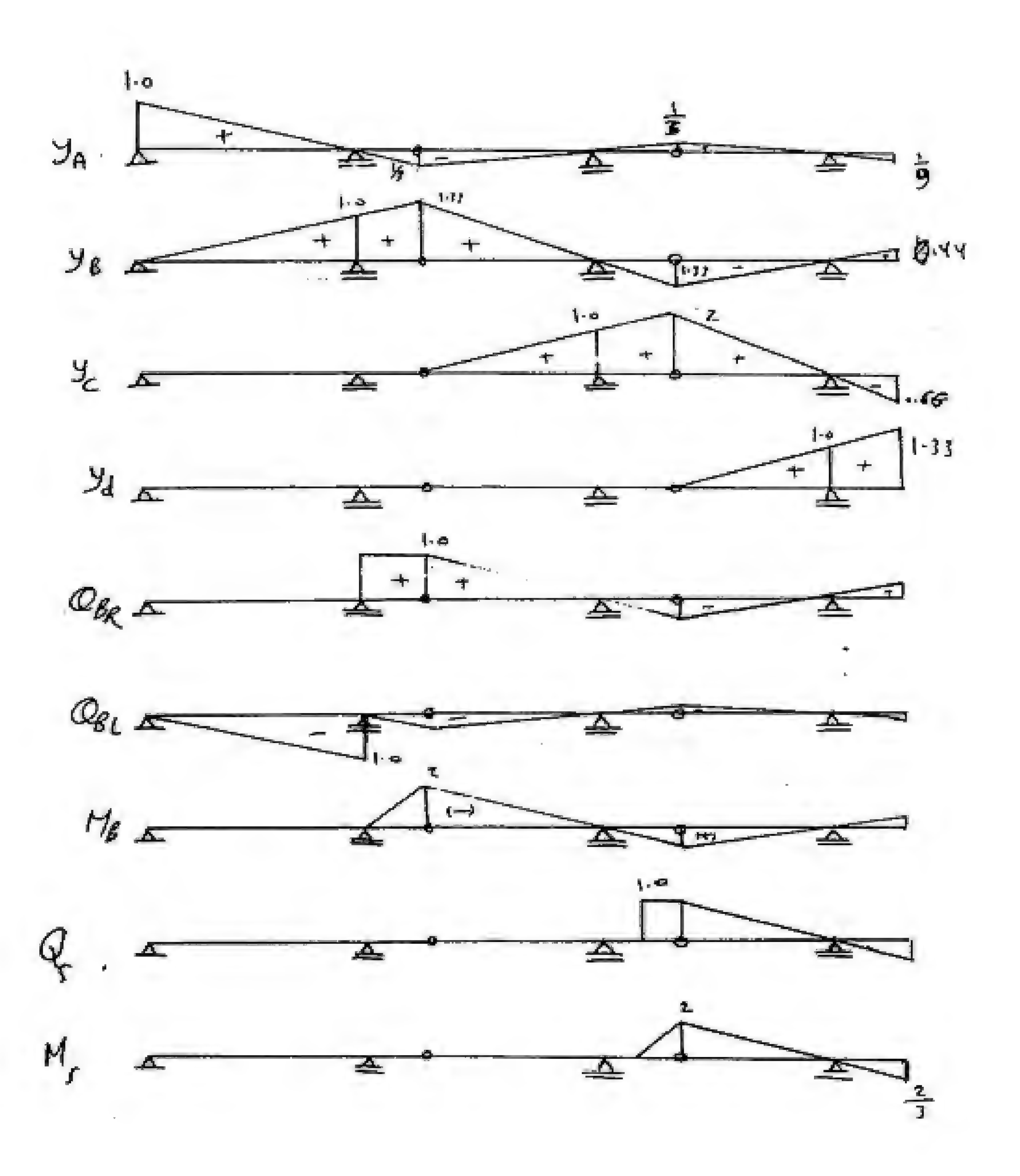


a) draw IL For $y_a, y_b, y_c, y_d, Q_{B_R}, Q_{B_L}, M_B, Q_S, M_S$

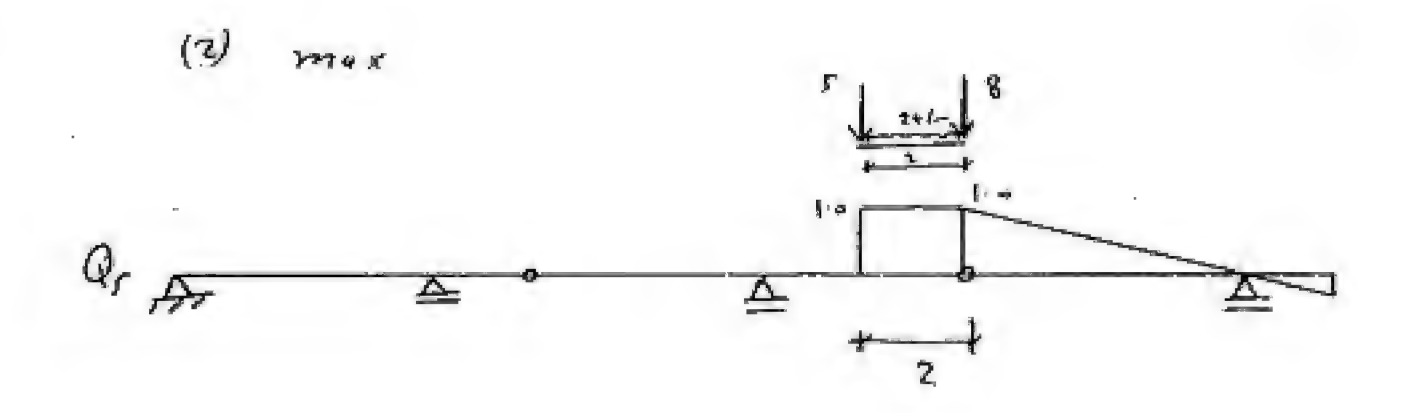
b) Q_S max due to 5 ↓ 2t/m ↓ 8 (2m)

— S.L —




1.0
y_A
1/3
1/3
1/9
1.0
1.33
y_B
0.44
1.33
1.0
2
y_C
.66
1.0
1.33
y_d
1.0
Q_{BR}
Q_{BL}
1.0
M_B
1.0
Q_S
2
M_S
2/3

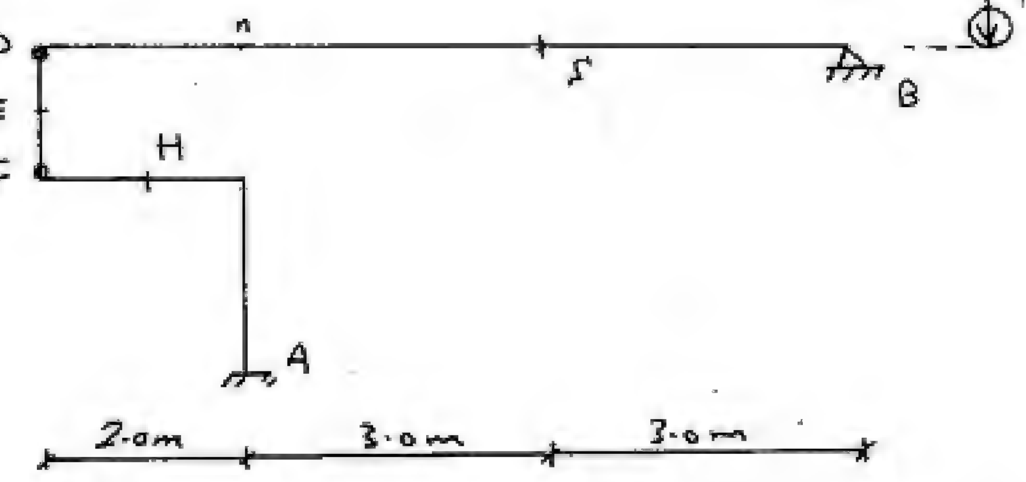
(3) max



$$Q_{max} = 5*1+8*1+2*(1*2)$$

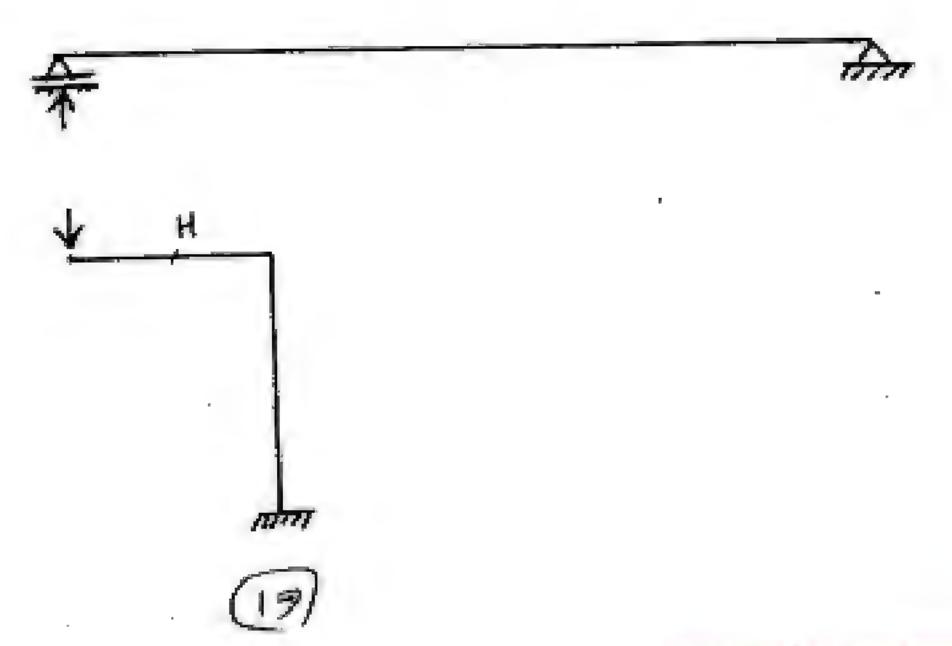
$$= 5+8+4 = 17 \text{ ton}.$$

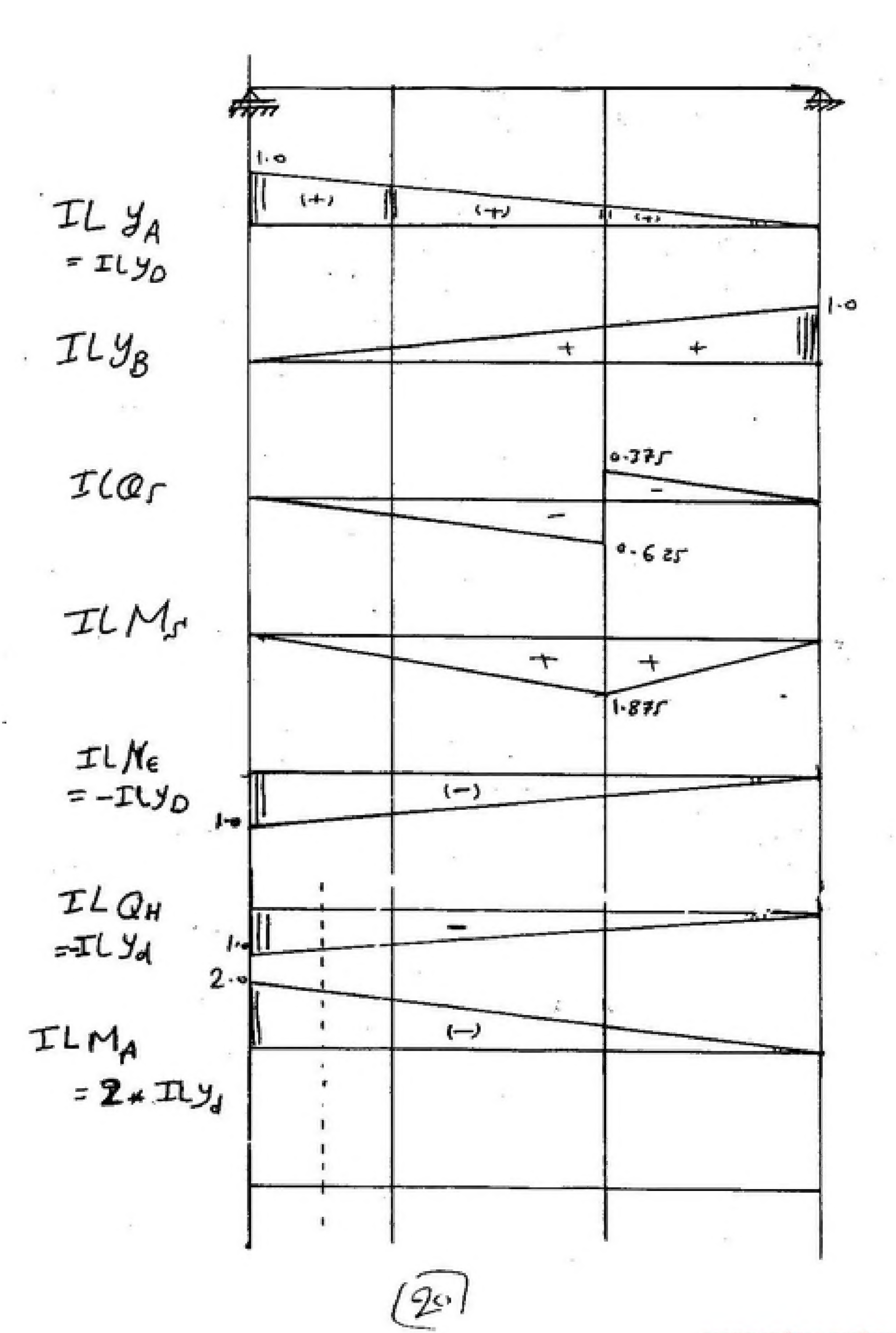
final 2006



draw $IL\, y_A, y_B, y_D, M_A, Q_S, M_S, N_E, Q_H$ for the shown frame.

Sol




1.0
IL y_A
= IL y_D
(+)
(+)
(+)
IL y_B
1.0
+
+
IL Q_S
0.375
-
-
0.625
IL M_S
+
+
1.875
IL N_E
= -IL y_D
(-)
1.0
IL Q_H
= IL y_d
-
1.0
2.0
IL M_A
= 2 * IL y_d
(-)

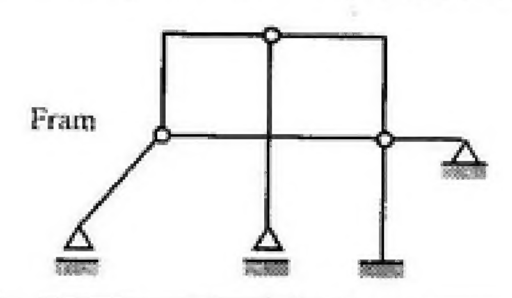
Course Name :	Structural Analysis	Final Term Exam	
Course Code :		Date	: 16/1/2008
Level :	1^{st}. Year – Civil Engineering	Time	: 3 Hours
Department :	Structural Engineering	No. of pages	: 2
Term No. :	One	No. of Questions	: 6

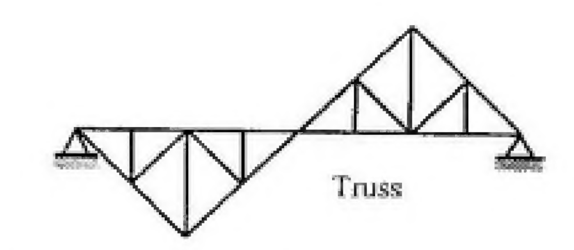
Zagazig University
Faculty of Engineering

Attempt All Problems, Full marks: 90 Marks

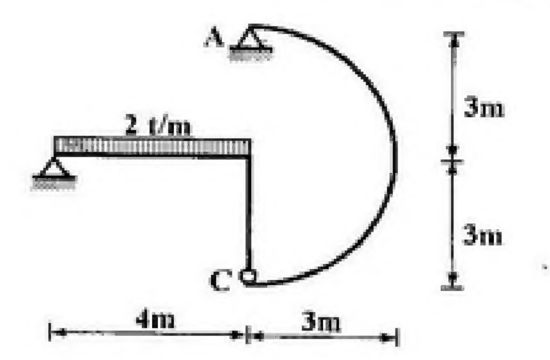
Problem No. 1 (20 Marks)

a) Check the stability and determinacy for the given structures. If they are unstable or statically indeterminate, show how they can be modified to become stable and determinate.



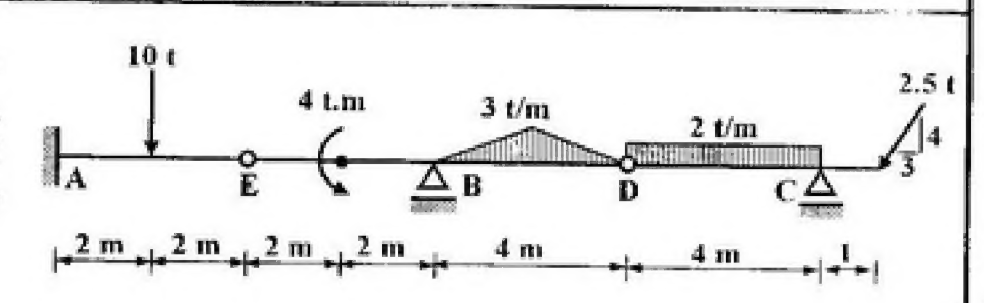


b) Draw the N.F., S.F. and B.M. Diagrams for the given circular arch:



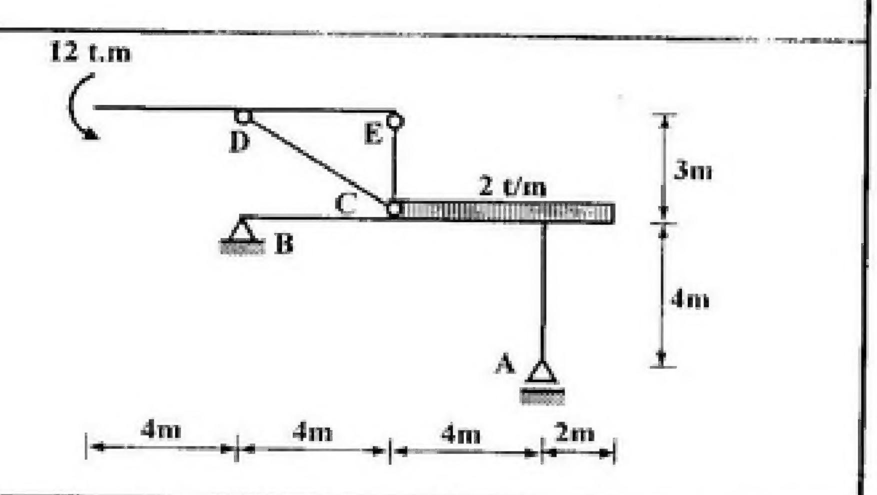
Problem No. 2 (20 Marks)

Draw the N.F., S.F. and B.M. Diagrams for the given beam, then, find the point on part DC at which the +ve B.M. equals the -ve B.M. at C.



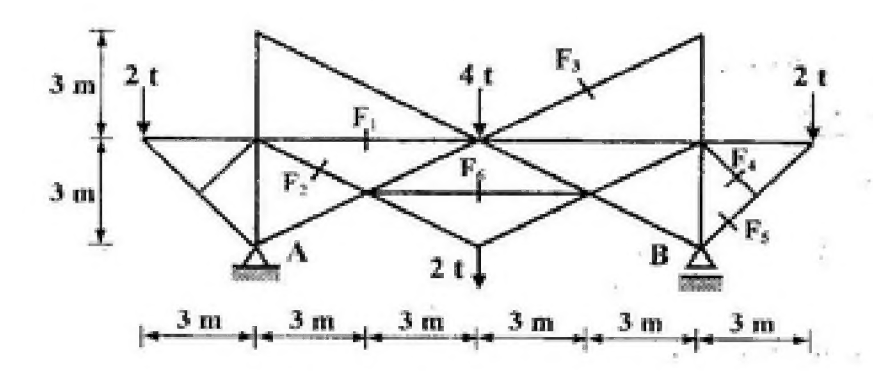
Problem No. 3 (20 Marks)

Draw the N.F,S.F. and B.M.Ds. for the given Frame:



Problem No. 4 (15 Marks)

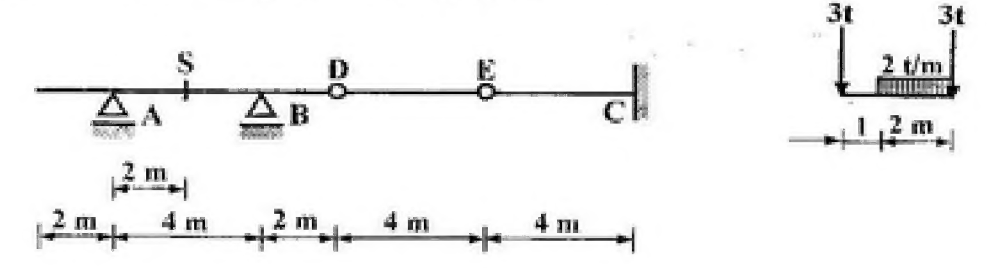
Fined the forces in the marked members for the following truss:



Problem No. 5 (15 Marks)

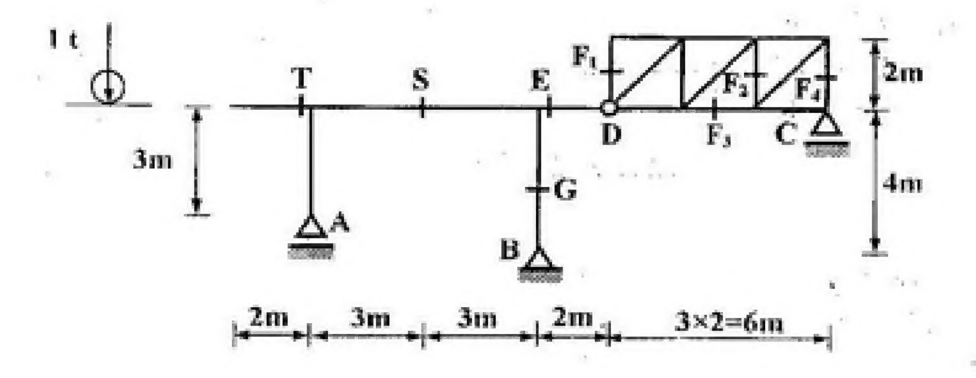
a) Draw the influence lines of Y_A, Y_B, Y_C, M_C, Q_{AR}, Q_{BR}, M_A, M_B, Q_D, Q_S and M_S.

b) Determine the max. M_S due to the given loading system:



Problem No. 6 (15 Marks)

Draw the influence lines of Y_A, Y_B, Y_C, Q_T, M_E, N_G, Q_S and M_S for the frame and the influence lines of the forces in the marked members of the truss:



Best Wishes,

Prof.Dr. Asharf M. El-Shihy

Ass. Prof. Hesham F. Shaaban *Dr. Tarek. M. Amin*

scanner & modified & upload

by

Mahmoud Ashraf

contact info

titanic_ship1912@yahoo.com